A·S·L·E

Lubrication ENGINEERING

JOURNAL OF THE AMERICAN SOCIETY OF LUBRICATION ENGINEERS

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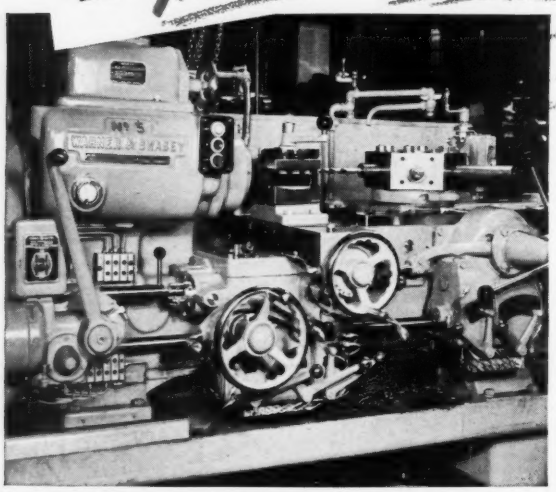
Let Trabon Automatic Lubrication Safeguard Them!



• Protect your machinery investment by specifying and buying Trabon lubricating systems. You can profit by Trabon's 20 years of experience in manufacturing oil and grease systems for industry.

Trabon oil and grease systems have these outstanding features: Completely Sealed —have no exposed moving parts . . operate perfectly when buried in dirt or under water.

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D. A. STUART'S THREDKUT straight, or in rich blend, provides fine finish on tough, stringy materials because its high sulphur content gives it excellent anti-weld characteristics.

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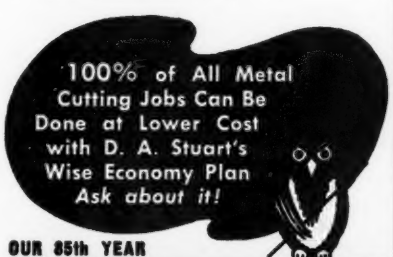
THREDKUT'S exceptionally broad range of usefulness makes it cost less than "cheaper" products in the majority of cases and often eliminates the need for several different types of oils. When it comes to *performance* on the jobs within its range, *none can best it!* Write for details and literature.



OUR 85th YEAR

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Lubrication ENGINEERING

VOL. 6 JUNE, 1950 No. 3

In This Issue

Officers and Directors—A.S.L.E. 110
The Editor's Page (President's Message) 111
Multi-Functional Lubricants—E. M. Kipp 112
Application of Wear Resistant Phosphate Coatings to Ferrous Surfaces —M. B. Roosa 117
Pumping Characteristics of An 180-Degree Journal Bearing— A. E. Roach 122
New Products and Equipment 127
News of the Sections 128
Current Literature 133
Patent Abstracts, Oils and Lubricants 135
Section Officers 140
Advertisers' Index 148

Special Features:

Cartoon 125
Convention Hi-Lites ... 126
Personals 132
Book Review 132
"Slipshod Americans" .. 132

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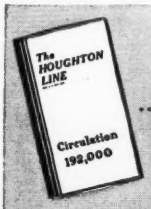
REG. U. S. PAT. OFF.

VOL. 18, NO. 2 JUNE, 1950



...the "near editor's" viewpoint...

Many folks who ask for advice really only seek approval.

The main difference between the atom bomb and the H-bomb is that the latter will kill a lot more people. The "civilized" world has gone insane on bombs. They may have helped win the last war, but they never settled any of the issues, and may even cause another war. We hope the much publicized H-bomb will be a complete dud!

Secret of "creosote" flavor of Scotch is revealed in the current "LINE." And one reader tells us that "it is common knowledge that Scots expectorate and shut their eyes before drinking theirs straight, to avoid diluting it with any moisture or from crying into it when they think of the price."

Aaron P. Carpenter

CHAIRMAN OF THE BOARD.

Stops Squealing

A screw machine manufacturer who is operating 62 automatics oiled spindles twice a day. He tried out three different oils, but found that spindles began to squeal after running about two hours, especially on the high speed automatics. Then he tried Houghton's Sta-Put—*no squeal* on the two-a-day oiling schedule. Naturally, he has standardized on Sta-Put, the high-film-strength, leak-resistant lubricant.

20,000 Gal. of Fuel Oil—Free

It may seem hard to believe, but up in Michigan a power company found, after treating its fuel oil with our Houghto-Solv to take tank sludge into solution, that it had 20,000 more gallons of usable fuel oil than showed on their inventory. Dip sticks went 14" deeper into the storage tank, showing that 14" of sludge had been dissolved and made burnable. Have you a sludge problem?

Hot Spots

A conveyor carrying work through a salt bath, although baffled from close contact with the 1,000° bath, presented a chain lubrication problem. Heat above the bath itself was over 400°, destroying ordinary lubricants and causing chain sticking. Houghton's Hi-Temp Oil 227 was recommended and tested. It worked; all links and wheels are free, the conveyor is clean, and there has been no carbon formation. Conveyor links are sprayed once each cycle with an automatic oiler; trolley wheels are gun-greased every two weeks.

Eight Lubes Should Be Enough

ONE of our field representatives was taking our lubrication engineer to a medium-sized plant to check over its lubrication requirements, at the request of the plant engineer. The Houghton technical man remarked as they drove up to the plant parking lot that "we can lubricate their machines with probably no more than eight varieties of oil."

"But you haven't seen the inside of the plant yet!" declared the salesman.

"No, but I've seen and surveyed a hundred which are very similar to it," said the lubrication engineer. "Let's park here a minute before going in, and I'll explain. And five will get you ten that's what we'll recommend here, and the brands we offer will do the job better than they may be doing it with at least twice as many varieties. That's been our experience in the past."

"O.K., shoot!"

"Here's what a plant of this type needs," explained the L. E.:

"1. A general purpose grease, such as our Sta-Put 18H. It's a mixed base grease, won't separate nor clog the lines. It combines a high melting point and resistance to water, thus batting for both soda and lime base greases. It's O.K. for automatic lubricators. But it shouldn't be used in electric motors.

"2. For motors, a soda-base pre-worked smooth grease like our Absorbed Oil 100 for fractional HPs, No. 200 for multiple HPs.

"3. A general purpose oil. I'd say our Sta-Put 320. It's one of the most-copied oils on the market. But no oil suppliers have combined high film strength and leak resistance the way we have.

"4. A medium gear oil — treated for extreme pressures — like our Vital E.P. Gear Oil SAE 140. If worm gears predominate, our ME Worm Gear Oil can be used instead. It is compounded but not E.P.-treated.

"5. A treated spindle oil of about a 65@100 viscosity, such as our Kensington Spindle Oil No. 7. The extreme-pressure treatment prevents early wear.

"6. A hydraulic oil. There are plenty of them on the market, all making somewhat similar claims, but I'll stand by our Hydro-Drive, a pioneer in treated hydraulic oils, which is fortified for oxidation stability, gum solvency, rust protection and film strength. Usually the MIH Light grade will be most generally used, but as you know, we supply it in all viscosities up to SAE 70.

"7. A headstock lubricant for gear boxes of machine tools. Here I'd advise our Hydro-Drive MIH-20. It's performing wonderfully for others, both in headstocks and as an air compressor oil. If compressors are air-cooled you'll need a heavier viscosity oil.

"8. An open gear lubricant, something that's tacky, adhesive, yet has plenty of lubricity. We have several such greases; I happen to prefer Sta-Put 567. Always tell the engineer to clean the teeth well before applying by brush or spray.

"Many plants have some special need which requires a special type lubricant. It may be a high temperature oil, or one which has a very low pour point for a cold condition, or a very bad water condition where only a lime-base grease will function properly. As you know, we have plenty of those special lubes.

"Those first eight, however, should do the average lubrication job and do it better than any combination anyone else can offer. Now let's go in and look over this plant."

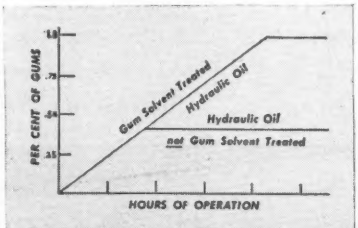
That is the simplest approach to a plant's lubrication needs. After a study of the individual machines an oiling schedule can be set up which will avoid most of the possibilities of human error. We call this plan the H.E.L.P.—Houghton's Engineered Lubrication Plan. May we discuss it with your man charged with the responsibility for proper lubrication?

1. *Antisep All-Purpose Base*—Folder describing water-soluble cutting concentrate which will handle 90% of machining needs.

2. *Hydraulic Oil Handbook*—56 pages of basic data on operation of hydraulically operated systems.

3. *Gum Solvent "B"*—Folder describing this first-aid treatment of badly gummed machines and hydraulic units.

4. *Hi-Temp Oils*—Data Sheet listing complete series for high temperature uses.



The chart compares the difference in service life between hydraulic oil without solvent properties and Houghton's Hydro-Drive treated hydraulic oils. The saturation point of the untreated oil is .35%, as measured by the Kissling Resins Test. Hydro-Drive's saturation point, in the same test, is 1.0%, over two and one-half times greater. Time intervals are not indicated on this chart which, however, represents comparative service factors that hold true at all intervals.

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How to make your machines Sing ...for a Song

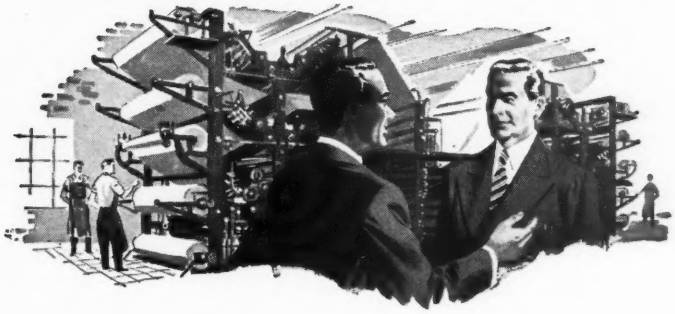
SWITCH TO CIMCOOL°, and listen to your machines humming in smooth, fast harmony. Then watch for an important scaling down of metal cutting costs. For this revolutionary cutting fluid—this *chemical emulsion*—saves you money three important ways:

- CIMCOOL INCREASES TOOL LIFE (and thus reduces down time) because of its *chemical lubricity*.
- FASTER SPEEDS are possible because Cimcool cools faster, through a unique physical change in the cutting fluid itself. Tools and chips actually stay cool to the touch.
- CIMCOOL COSTS LESS than old-fashioned cutting fluids because it lasts longer. It also cuts cost of cleaning and changing. It virtually eliminates rancidity and foul odors. And because of its low surface tension and low adhesion to work and chips, there is practically no carry off.

Write for free booklet, "CIMCOOL Gives the Answers." Address, Sales Manager, CIMCOOL Division, The Cincinnati Milling Machine Company, Cincinnati 9, Ohio.

°Trade Mark Reg. U. S. Pat. Off.

How to Cut a Production Expense *from $14 Daily to* 21 cents!



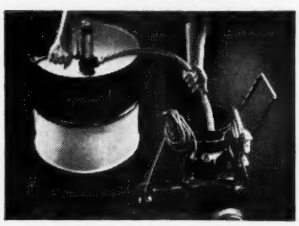
This represents a saving of over $3000 every year to a Clinton, Mass. company.* It was made possible by solving the kind of problem that may be cutting profits—daily—in YOUR plant, too!

A survey of plant methods revealed that machines had to be stopped a half hour in every 8 hour day, for lubrication. Could this $14-a-day expense be trimmed? An Alemite Lubrication Engineer recommended a system that lubricates all machines automatically while they're running. The result—lubrication cost was cut to only 21 cents a day! And this saving alone paid for the whole investment in 43 days!

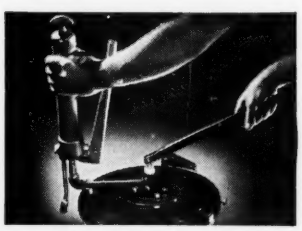
No matter what size or type of plant you operate, Alemite can show you dozens of ways to make worthwhile savings through more efficient handling of petroleum products. These are facts which you can readily confirm in your own time studies. Contact your local Alemite Industrial Distributor now. Or send for free booklet "11 Ways to Cut Production Costs." Simply attach coupon below to your letterhead. Alemite, Dept. P-60, 1850 Diversey Parkway, Chicago 14, Ill.

**Name on request*

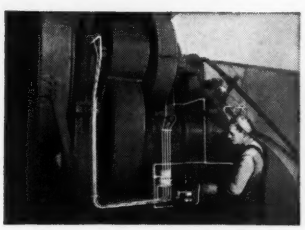
Alemite Cuts Costs 3 Ways



1. ***In Transferring Lubricants...*** by eliminating mess, expensive contamination—and cutting man hours 63% for every 100 pounds of lubricant transferred.



2. ***In Loading Grease Guns . . .*** by saving 3¾ man hours for every 100 pounds of lubricant loaded into hand guns.



3. ***In Applying Lubricants . . .*** by saving up to 23.9 man hours for every 100 pounds of lubricant applied to bearings.

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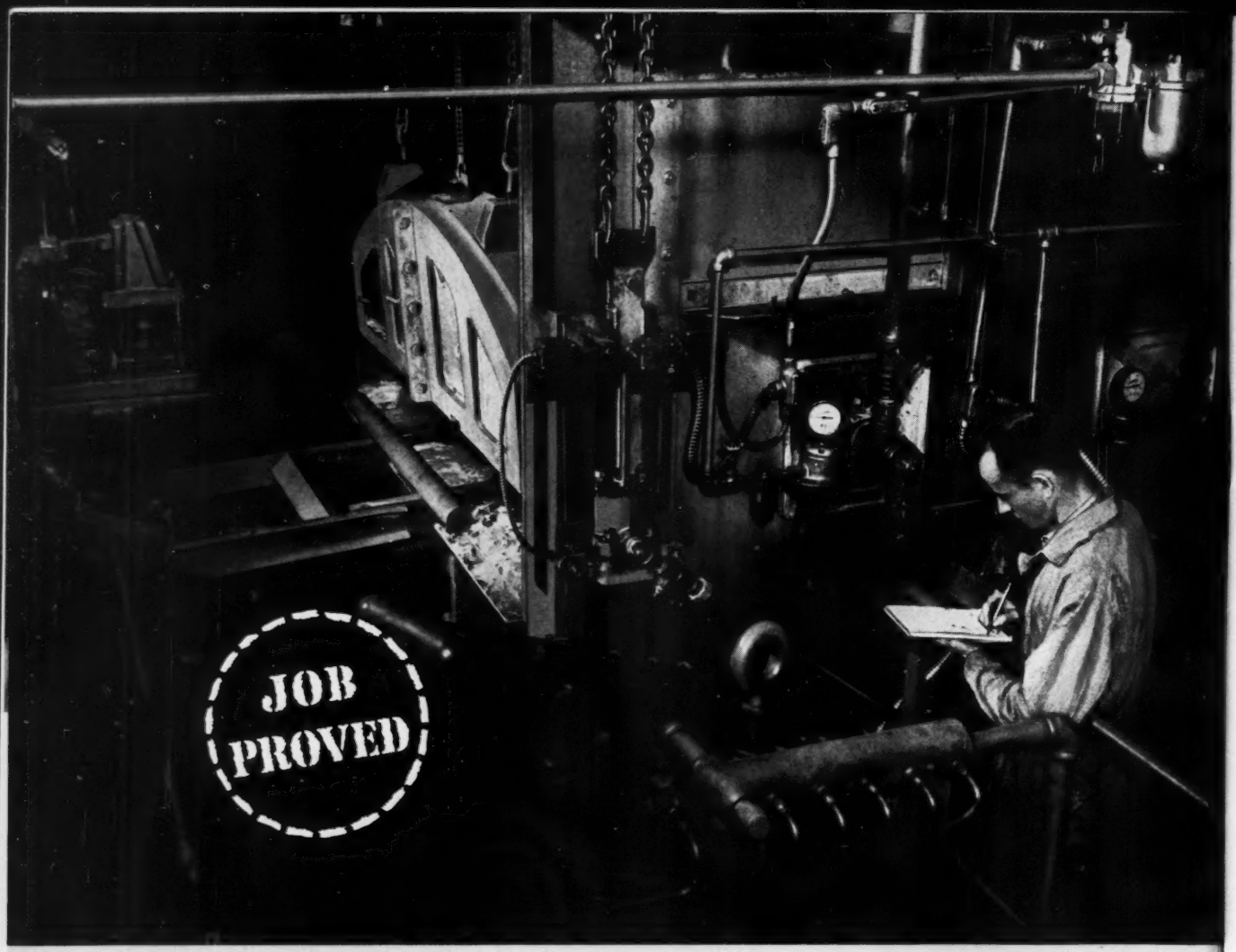

HYDRAULIC SYSTEM KEPT LIKE NEW

Sunvis 916 Effects Substantial Savings; Strainers and Lines Kept Sludge-Free

A copper tubing manufacturer uses an oven with hydraulically operated doors to heat billets to approximately 1550F. The ambient temperatures around the hydraulic mechanism are abnormally high, putting the hydraulic fluid to a severe test of stability. Failure of the system would halt the piercing operation and result in costly delays throughout the plant.

Since the oven was first put in operation, three years ago, the hydraulic fluid has been Sunvis 916. The original charge has never been changed and is still in excellent condition, though the system is tight and requires only a minimum of make-up. Oil lines and strainers are completely free of sludge. Seals and packings are sound. Operations are never interrupted for oil changes or parts maintenance. The company expects to retain the original charge of Sunvis 916 in service indefinitely, effecting large savings in both oil and maintenance costs.

Sunvis 916 is a solvent-refined oil of the highest quality. It is fortified to resist the oxidation and sludging so detrimental to the efficient operation of hydraulic systems. Sunvis 900 Oils are *good for the life of your machines.* For your copy of the illustrated booklet "Sunvis 900 Oils" write Department L-6.

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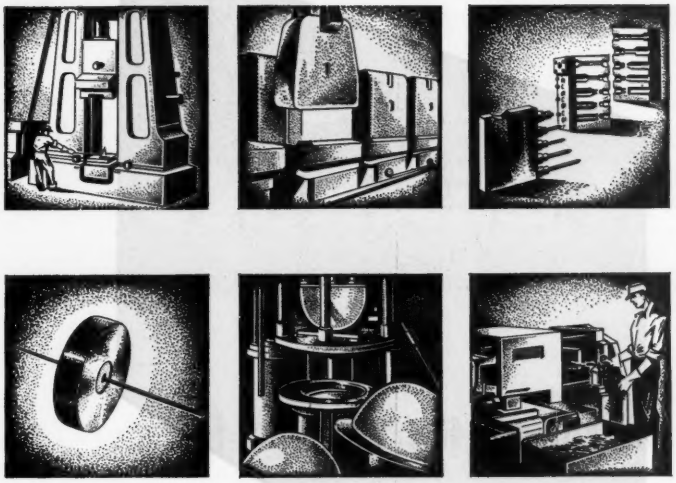

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In deep piercing you get smooth forgings, close tolerances, and reduce wear on dies. In casting and mold stripping you get smooth surfaces, clean parting, fewer rejects; and additional mold life.

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In stretch-forming you reduce tearing and rippling. In wire-drawing you get perfect diameter, smoother finish and greatly extended die life.

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The NEW Acheson Bulletin #426 on the Use of **"dag"** Colloidal Graphite in Metal-forming Operations is just off the press . . . a copy is ready for you if you will fill in and mail the coupon.

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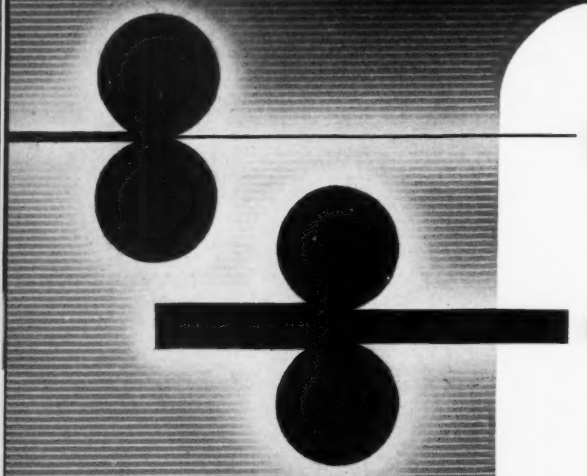

for rolling the thinnest foil

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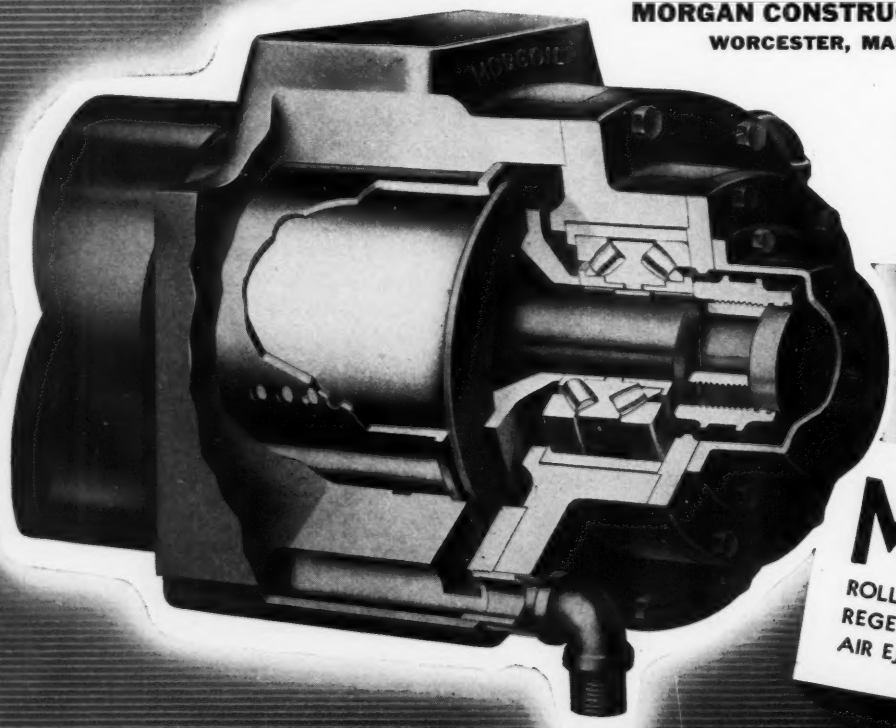

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NEW YORK OFFICE 257 FOURTH AVENUE

March 10, 1950

Lincoln Engineering Co.
8 St. Mary's Street
Boston, Mass.

Gentlemen:

We have had the Lincoln Centromatic System installed on our frames since we purchased them and we are more than satisfied with its performance.

Two or three things which we noticed which might be of interest to you. One is the increase in Traveler life over what we expected. From what information we can gather from nearby mills using the same type of frames and same yarns, our Travelers are lasting from three or four times as long. We have no down-time required for oiling and our frames are much cleaner as a result of this installation. As a result of the effective lubrication, we notice a marked reduction in ends down.

The maintenance on this system is negligible to date and, in short, we would be pleased to recommend it to anyone contemplating installation.

Yours truly,

DORR WOOLEN COMPANY

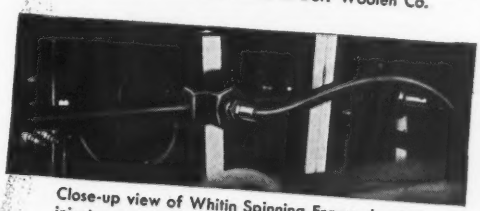
President

GAD,Jr:P

Saves DOWNTIME **Increases** TRAVELER LIFE

Centro-Matic Lubrication System installed on (14) 120 Spindle Whitin Spinning Frames at Dorr Woolen Co.

Close-up view of Lincoln Centro-Matic injectors installed on Whitin Spinning Frames at Dorr Woolen Co.



Close-up view of Whitin Spinning Frame showing how injectors on each rail section are supplied with lubricant independently from the main supply line down through center of frame.

***Lincoln's* Centralized Lubrication Provide**

Lincoln's Lubrication System specialists will work with you and recommend the time and money saving Centralized Lubrication System best suited to your equipment. Phone or write

Right LUBRICANT QUANTITY TIME **Automatically**

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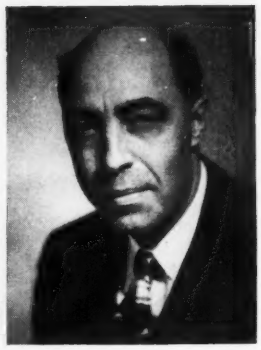

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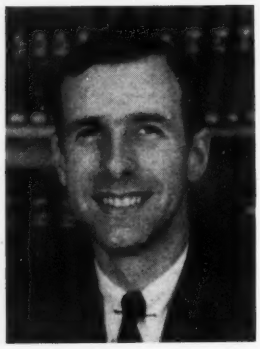

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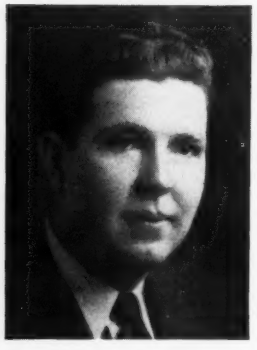

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PRESIDENT'S MESSAGE

Dwight F. Hollingsworth, supervisor of the mechanical improvement group of the Du Pont Company's Engineering Department, has been engaged in engineering work for the company since 1936.

Born January 28, 1910, in Tipton County, Ind., he was awarded the degree of bachelor of science in mechanical engineering at Purdue University in 1932 and received the degree of master of science in engineering from the same university in 1936. Mr. Hollingsworth was on the Purdue University staff while studying for his master's degree.

He joined the Du Pont Company in 1936 as a junior process improvement engineer at the Chambers Works in New Jersey. He was located in the Du Pont Company's Waynesboro, Va., plant and the Grasselli, N. J., plant before coming to Wilmington in 1939 as junior lubrication specialist. Prior to his present position, he became a lubrication consultant in the Engineering Department in 1943 and was named supervisor of the mechanical improvement group in 1949.

He is a member of the American Society of Mechanical Engineers, the Reamer Club, Pi Sigma Tau, and Sigma Xi. In 1950 he was elected president of the American Society of Lubrication Engineers.

Mr. Hollingsworth married the former Miss Helen Greene of Virginia on July 1, 1939. They have two sons and a daughter and live at Colonial Farms, Avondale, Pa.

The membership of our Society and industry which it represents is responsible for the rapid and sound growth of the American Society of Lubrication Engineers and will always be most vital to us. We are particularly indebted to that small group of men who had the foresight, courage, and perseverance to form A.S.L.E. in 1944, a time when world conditions were adverse to new ventures. Then, restrictions on travel were often a handicap as were other factors such as the availability of time required for technical and organizational meetings and the lack of materials necessary for starting a National Society. However, these men did not lack enthusiasm; which in turn was transmitted to each new member, giving the impetus needed to grow, in spite of the many obstacles which were encountered. The Society has had help through the financial aid of membership dues, advertising in LUBRICATION ENGINEERING, and the sponsorship of our three annual exhibits. True, the Society could not exist without financial aid to carry out its growing list of activities. However, the most important factor in the Society's growth and success is the time and personal effort so generously given by our individual members.

If the time contributed to A.S.L.E. by its members could be evaluated, we would no doubt be surprised to learn that our Society represents an investment of several hundred thousand dollars. Like many other technical groups, our Committee members, Directors, and Officers, both local and national, excepting our National Secretary, all serve without remuneration of any kind. To their employers—the oil companies, the equipment manufacturers, the research and educational institutions, and the consumer industry—we owe our gratitude and thanks that A.S.L.E. has grown to what it is today.

It is the responsibility of the Officers and Directors and every member of A.S.L.E. to protect this investment for all industry and, selfishly, for ourselves. Not only must we safeguard and increase this equity, but an obligation rests with us to provide a commensurate return to our Society investors. Without something to give, we cannot long survive, and A.S.L.E. has given us a lot for our money.

As discussed on this page by other authors, we have a fine Technical Journal devoted exclusively to lubrication. Our annual exhibit offers a showing of the latest developments in lubricants, lubrication equipment and practice. Our annual convention and local meetings are devoted entirely to the many phases of lubrication. Increased membership has enabled the Society to publish a number of badly needed books and pamphlets, to undertake a bearing research project, to initiate lubrication courses in a number of colleges, and to provide other valuable services to American industry.

We have grown rapidly and established Sections from coast to coast. In this sixth year of our existence, we must devote ourselves to strengthening the Society and consolidating our gains. A real challenge lies ahead of us—we require more members, and we must further prove ourselves to industry. We have not yet gained the professional standing which lubrication engineers deserve, and our Society is striving to attain. Some of these will come with time, but one thing stands out as most important and that is the need for additional Society memberships.

DWIGHT F. HOLLINGSWORTH

MULTI-FUNCTIONAL LUBRICANTS*

by E. M. Kipp
Aluminum Research Laboratories
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Dr. Egbert M. Kipp obtained his A. M. degree from Boston University and his Ph. D. degree from Pennsylvania State College. He joined the staff of the Aluminum Company of America as a member of the Physical Chemistry Division in 1939; was made Assistant Chief in charge of the Oils and Lubricants in 1944, and became Chief of the Lubricants Division in 1947.

Dr. Kipp is past president of the American Society of Lubrication Engineers and has served as chairman of several of its national committees. He is a member of the Pittsburgh Section of the American Chemical Society, the Pittsburgh Chemist's Club and numerous honorary societies.

The total number of individual lubricant items, whether they be oils, greases, synthetic fluids, or other types which may be required for effective lubrication of industrial machinery of all types, is a matter of immediate interest to the manufacturers and vendors of lubricants, to the manufacturers of industrial machinery and machine tools, and to their customers.

As is so often the case, definition of the problem and the methods which may be offered in solution thereof will vary with the particular point of view. Perhaps we may best bracket the problem by briefly outlining two widely divergent approaches to the problem.

At one extreme, we may postulate that when the ultimate in knowledge is attained, it will be possible to design an all-purpose multi-functional lubricant in such an ingenious and effective manner that this lubricant will be found to provide whatever properties may be required of it by any conceivable machine element or combination of machine elements operating under any given environment. If such a universally applicable lubricant were to be achieved, we would of course be confronted with a universal solution to our lubrication problems. This would indeed represent an interesting state of affairs for all concerned, but one with which, unfortunately, we do not expect to be confronted in the immediate future.

An opposite and perhaps equally extreme approach would be to consider each individual machine element and a given set of associated conditions of operation such as temperatures, speeds, loads, and the like as a specific problem of lubrication unique unto itself and for which a single specific lubricant tailor-made only for this single application would be required. On this basis we would visualize then the need of developing the thousands of specific lubricant items that will be required to fulfill the corresponding thousands of combinations which would be involved and all the attendant complications of application, storage, purchasing, manufacture, etc.

The conditions most likely to prevail on the basis of practical realities will represent a happy medium between the two extremes outlined. It is of course recognized that this happy medium will be a function of the particular circumstances involved, and will vary from consumer to consumer in accordance with the nature and extent of his operations. These variations in lubricant requirements will be accentuated as the lubricant becomes more highly specific and narrow with respect to its properties—in other words, mono-functional rather than multi-functional. The suppliers and vendors of lubricants would, under these circumstances, be expected to utilize their knowledge, ingenuity, and facilities to the utmost, in conjunction with the consumer, so that each consumer would attain or approach his particular most effective over-all balance between number of lubricants and over-all costs with the fewest possible number of complications for all concerned.

It may be useful at this point to ask why this subject was brought up in the first place. A subject obviously so complex and often of such controversial nature might prudently have best been politely ignored or at least delicately sidestepped. It is true that the nature of this problem will vary with the nature of the consumer's operations, capital investment for machinery, total quantity of lubricants consumed, relations between lubricants and quality of product, over-all costs, and the like. Nevertheless, the general advantages of lubricating a plant or number of plants most effectively at lowest possible over-all cost with the fewest number of lubricants practicable are so self-evident as not to require detailed discussion at this time. From the consumer's point of view, his problems with respect to selection, purchasing, storage, and application of lubricants, will decrease in direct proportion to the number of lubricants involved.

Other factors, such as establishment of the performance characteristics of lubricants, relationship of lubrication to designing of equipment and development of improved operating procedures, will also become more straightforward as the numbers and types of lubricants are diminished.

The problem of selection of lubricants is a major one from the point of view of the consumer. The variety of lubricant products available on the market are so numerous as to be confusing. At best, it is not always clear to the consumer why one lubricant is necessarily more effective than another. Recommendations obtained from various lubricant suppliers, all of whom are presumably competent and experienced are oftentimes apparently contradictory. Streamlining of lubricants and the development of succinct, concise, and adequately defined "menus" of available lubricants on the basis of pertinent physical, chemical, and operating properties, would be most helpful. The advantages of simplification of lubricant items through the development of lubricants which can satisfactorily meet, individually, as wide a range of operating conditions as possible, are obvious. And, indeed, the oil industry is already doing some remarkable things along these lines. The more jobs that one lubricant can satisfactorily perform, the fewer are the lubricants that will be needed.

From the manufacturer's point of view, development

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of multi-functional lubricants, insofar as may be practicable, would obviously ease problems of manufacture, control, storage, sales, and service engineering. In this connection, we consumers must assume a great deal of the blame for the delay in development and acceptance of multi-functional lubricants because of our often unfounded insistence upon our need for a lubricant with certain properties which may actually be of little or no significance with regard to the intended end applications. It would seem to be a readily acceptable proposition that the fewer lubricants with which we must contend, the simpler will our jobs become with regard to matters of lubrication both for the manufacturer or vendor and for the consumer and design engineer.

Therefore, it would appear to be timely to consider whether the development and use of multi-functional lubricants are practicable and advisable. It may be of interest to illustrate the problem in a brief and general manner by considering only a representative few of the major physical or chemical characteristics generally regarded as variables of first order magnitude in the majority of large scale applications.

Viscosity

It is generally agreed that viscosity is the most important single property of a lubricant. This is particularly true in those many instances where the success of the operation depends upon the formation of a continuous film of oil between the rubbing surfaces. In these instances, it is necessary that the film of oil be able to build up within itself the necessary pressures to satisfactorily carry the unit loads involved. The role played by the viscosity variable is therefore a function of rubbing speeds, unit loads, bearing clearances, surface finishes, machine element geometry, operating temperatures, and the like. The criticalness of the viscosity variable is in direct proportion to the degree of refinement in the design of the machine elements and the extent of the limits and control imposed upon the operating variables.

It is true that there are some machine elements whose design features are so critical and which operate under such closely controlled conditions of humidity, ambient and operating temperatures, speeds, loads, and the like, that the magnitude of, and variations in the viscosity variable are matters which must be controlled within close tolerances. These cases, however, definitely are in the minority and are not representative of industrial applications in general. The majority of industrial applications are such that large margins of safety in the design of the machine elements are provided in order to meet the rather wide variations in operating conditions. Thus, necessarily, the viscosity variable ceases to be critical and becomes a matter of secondary concern. In any representative industrial plant, what proportion of bearings, gears, and the like are so critical and uniform with reference to design and operating conditions as to highlight the viscosity variable to such an extent that variations of a few percent in viscosity are matters of practical concern?

A recent brief review by the writer's company of the commercial availability of lubricants in connection with some committee work in one of the technical societies indicated that within the range of viscosity of from 30 SSU/100 F. for kerosene to a viscosity of 3000 SSU/100 F., it is possible to purchase oils of any desired viscosity within steps of plus or minus 25 SSU/100 F. of whatever viscosity may be specified. Thus, oils are commercially available, for example, of 100, 125, 150, 175, 200, 225, 250, etc. SSU/100 F. This apparent accentuation of the viscosity variable is, in the opinion of the writer, entirely unjustified for a great majority of industrial applications.

Consider the effect of only a single operating variable, for example, such as the bulk and/or operating temperature of the oil in a circulating system. In general, these oil circulating systems are not handled as constant temperature baths, and their temperatures are quite likely to vary within a range of 5, 10, 15, or even 25 F. All too often the extent to which variations of a few degrees in temperature will affect the viscosity of an oil, while well known, is not generally recognized. A pertinent practical illustration of this point was recently made by W. E. Hamilton[1], with reference to a typical application in a representative steel plant.

In Mr. Hamilton's plant, it was necessary to select lubricants for two mills. On the basis of available recommendations, one of the mills was lubricated with an oil of 2450 SSU/100 F., while an oil of 1750 SSU/100 F. was selected for the other mill. Assuming a normal operating temperature of 100 F. for each system, the temperature was actually found to fluctuate between a low of 92 and a high of 110 F. for each system. If an operating temperature of 110 F. is assumed for the mill presumed to require an oil of 2450 seconds at 100 F., it was found that this oil would actually drop in viscosity to a value of 1750 SSU, which is the viscosity value of the lighter oil specified for the other mill system. Similarly, if the temperature of the oil in the mill system requiring a 1750 SSU/100 F. oil were assumed to drop from 100 to 92 F.—a not uncommon occurrence incidentally—then the viscosity of the 1750 SSU/100 F. oil was found to increase to a value of 2450 SSU F., which is the viscosity of the oil deemed necessary for the other mill system. If the initial differences in viscosity were a matter of more than academic interest, these mills should not have continued to operate satisfactorily as they did when the variations in viscosity such as were indicated took place. This suggests, to paraphrase one of Mr. Kettering's points, that we might well ask of ourselves if we were ever bearings in a rolling mill. Presumably the mill will know what oil it requires to operate satisfactorily and will so indicate by its performance.

An even more detailed and striking practical illustration of the confused picture with regard to the viscosity variable and performance characteristics of lubricants, is given in the very interesting paper by John F. Pelley[2]. In his paper, Mr. Pelley clearly illustrates the wide divergence of opinion regarding this matter and as a specific example cites the case of three Bloomers with practically identical tooth pressures and gear speeds. The lubrication requirements of these three mills, however, are being satisfactorily met with oils ranging in viscosity values from 300 to 4200 SSU/100 F.

Even in the case of precision journal bearings designed to take full advantage of hydrodynamic principles of lubrication, a minimum viscosity limit is of greater importance than are variations in viscosity above this limit. It would therefore seem entirely practicable and certainly desirable to recognize the practical considerations involved and to organize the present availability and use of lubricants insofar as viscosity variable is concerned into a small number of specific viscosities, with rather generous spreads in upper and lower limits for each nominal viscosity value. For example, in the standardization program of the author's company, we have covered a range of viscosities from 25 to 10,000 SSU/100 F. with only 21 specific viscosities. Of these, the majority of our lubricant requirements are covered by only 11 nominal viscosities, with associated tolerance limits, and covering the range of from 100 to 5000 SSU/100 F. This situation, involving as it were the use of not more than a dozen or so viscosities, contrasts with

a previous situation wherein several dozen specific lubricant items were employed on the basis of many different viscosities with narrowly restricted limits.

It is strongly urged that the vendors and manufacturers of lubricants and their clients through the cooperation of various technical bodies set up a spectrum of viscosity values with associated tolerances which would constitute a simplified practical "menu" from which the required products would be selected insofar as the viscosity variable is concerned. These viscosity bands might well be given and carry some standard number coding which would be accepted industry-wide and by the public at large in much the same manner as has been done throughout the automotive industry with reference to crankcase oils. This would not in any way restrict competition nor would it attempt to define quality of the product or operating characteristics dependent upon quality of product. Rather, it would reduce a physical variable to a logical numerical basis which would be of great value in the formulation of a simplified yet effective "menu" of lubricant products to the advantage of both the manufacturer and of the consumer.

A realistic approach to this matter would find magnified benefits with reference to simplification in that the same basic scheme of viscosity schedules could be extended to oils representing many different uses, such as gear oils, oxidation inhibited oils, power system oils, and the like.

Stability Characteristics

By the term "stability characteristics," we have reference to the ability of a lubricant to maintain its desirable "as new" qualities as long as is possible under a variety of operating conditions. Obviously this characteristic would not be of particular interest in wasteful applications, or under conditions where the quality of the oil is of minor importance. In general, oils of poor stability will tend to develop sludge, varnish, acids, and other by-products of oxidation rather rapidly under conditions of elevated temperatures, excessive contact with air or oxygen, various types of metallic catalysts, moisture, and other contaminants. Oils of exceptional stability, on the other hand, will resist these deteriorating effects for longer periods of time under more severe conditions. The various fluids which presently are available as lubricants for use in circulating systems obviously represent a broad range of stability characteristics.

With reference to petroleum oils, we can consider the availability of widely divergent materials such as black oils; straight minerals oils of various degrees of refining, blending, and sources of crude; oxidation inhibited oils; rust and oxidation inhibited oils of the highly stable turbine oil variety; various highly compounded oils such as extreme pressure gear oils, heavy duty crankcase lubricants; and where cost or need permits, a variety of synthetic fluids. From among these numerous products it is possible to select a lubricant of virtually any desired degree of stability or instability.

One philosophy of operation would be that of selecting a product whose stability characteristics would be just those required for the particular specific application in mind. This then would involve the use of a relatively large number of different products, each of which would be precisely matched to the particular conditions of a specific job. However, it would seem, on the basis of over-all considerations, a much more practical approach to use fewer oils of superior stability and of a multifunctional nature in as many applications as would represent an over-all economic advantage.

Under this system we admittedly would be using in a varying number of applications oils of greater stability and quality than might be required by that particular application. However, against this factor, the added advantages of fewer lubricants, relationships between initial cost of lubricant and capital investment represented, added protection against outage times, and other possible failures due to lubrication, must be considered.

It would appear from the literature, from various oral communications to the writer, and on the basis of discussions presented at various technical meetings, that there is a great deal of concern with reference to the need for accurate classification and measurement, on a laboratory basis, of the stability characteristics of a given oil on an absolute basis, and with good correlation with field performance. We are of the opinion that much of this concern is a result of an unwarranted attempt at grading of oils on a much more detailed scale and with higher "resolving power" than is presently warranted by either the reproducibility or accuracy of any known laboratory oxidation test procedures or by the accuracy or control of operating variables characterizing many production operations. An analogy to the point we wish to make would be that of the mathematician who carries his figures to the fourth significant place in his computations when the accuracy of his data is good only to the first decimal place.

Any one who has been associated with typical industrial operations will realize that operating conditions in sum are apt to vary widely, and often to such a degree as to be more controlling than relatively small differences as measured in a laboratory oxidation life test, and which thus may become matters of academic interest only.

For these reasons it would seem to be a more sensible and realistic approach, in combining laboratory tests with field applications, to begin with a rough stability classification system free from close grading, and to then refine this oxidation stability grading system only as experience, know-how, correlation with field practice, and control of operating conditions make it desirable to do so. Under this approach it is suggested that stability of oils be classified into as few as three (or, if you twist my arm hard, a half dozen) grades such as excellent or outstanding, average, and poor. It has been our experience that several well known laboratory oil oxidation tests will agree surprisingly well in their rating of oils if the rating is not attempted on a too closely graded basis, or with an unwarrantedly high degree of "resolving power."

With respect to the application of multi-functional lubricants such as the R & O type turbine oils, and heavy duty crankcase oils of the 2-104B types, these offer an interesting and potentially valuable tool in developing optimum lubrication with greatest possible simplicity and lowest over-all cost. As perhaps an extreme example, it would be possible to argue a rather strong case even for the use of heavy duty crankcase oils in a wide variety of applications other than their intended application as internal combustion engine crankcase oils. For example, oils of this type would often do a surprisingly satisfactory job in many hydraulic applications, lightly loaded gears, many bearing lubrication jobs, and the like. The worst that can be said with regard to operating characteristics is that under such a plan, there might be numerous applications where the outstanding detergency, dispersibility, oxidation stability, and bearing corrosion inhibition properties of such oils would not be utilized.

Granting this fact, in a great majority of such applications, these additional characteristics will do no harm and may on many an occasion be of unexpected value. It would seem to be a highly realistic point of view to accept the fact that the cost of the oil is but a minor

fraction of the investment in machinery and the much greater potential economic losses due to interruption of production, etc.

Likewise, the multi-functional lubricants, if properly selected, will often give longer periods of satisfactory operation and in this way may often justify the higher initial costs if any. Sometimes, multi-functional lubricants of this type compare favorably in cost with highly refined good quality straight mineral oils by virtue of the fact that it is frequently possible through the use of properly selected additives to simplify the refining procedures and their attendant costs.

Therefore, a practical procedure of lubrication which would emphasize the widest possible use of a multi-functional lubricant, merits careful attention. Under such a program, a multi-functional lubricant would be utilized in all closed systems except those where leakage or other losses are high or where operating conditions are obviously mild. Straight mineral oils of good stability would be utilized in those circulating systems where rusting is not a problem, where operating temperatures are moderate, and where other requirements are not extreme. Finally, low grade asphaltic residuum type or other low cost oils would be utilized in those circulating systems where leakage is a serious problem with attendant large loss of oil and large volumes of make-up.

Under such a plan the multi-functional characteristics of a lubricant become pertinent. An oil which is properly oxidation inhibited to possess extremely high resistence to oxidation under as broad a temperature range as possible, one which has adequate viscosity-temperature characteristics, one which provides good protection against formation of rusting or corrosion, and one which will have the ability to maintain any sludges or other finely divided solid material in finely dispersed suspension, will obviously find broader and more generally useful application than an oil possessing only one of these desirable operating characteristics. This entire philosophy, of course, will be justified only to the extent that standardization and simplification of lubricant products is economically sound under any given set of operating conditions on an over-all cost basis reflecting maintenance costs and the like.

Extreme Pressure Type Lubricants

Under this designation, we have rather broad and general reference to those lubricants which, by virtue of blending with various types of chemical additives, possess the ability to maintain satisfactory lubrication under higher unit loads than would normally be possible or feasible with straight mineral oils. Here again, the general philosophy with reference to multi-functional lubricants and the problems associated with this philosophy, are analogous to those discussed in the preceding section with reference to stability characteristics of oils. As before, we are dealing with a property of a lubricant which is not easy to define, maybe even harder to measure, and still more difficult to interpret and apply.

However, as in the preceding section, it is suggested that much of the confusion and apparent contradictory data are the results of attempts to proceed in this phase of lubrication as though it were a quantitative science lending itself to quantitative measurements such as those which might be made with a precision analytical balance. With reference to this type of lubrication, better practical results will be forthcoming if attempts at grading various lubricants with regard to "film strength" (for lack of a better term) and associated factors are not carried to the point where small measurable differences as detected on laboratory apparatus such as the Falex, Almen, Four-Ball, etc., are no longer of practical significance.

Progress in the manufacture of heavy duty gear lubricants, for example, has been outstanding, and it would appear entirely feasible and practicable to employ such lubricants as multi-functional lubricants for all applications in which the use of straight mineral oils would involve any question at all as to suitable protection against seizure, wear, scuffing and galling, and the like.

Considerable experimental data are currently being obtained by our Company regarding the feasibility of utilizing multi-functional heavy duty gear oils in the lubrication of a wide variety of gear applications. The results to date have been most favorable and suggest that some of the better heavy duty type gear oils can be effectively used as multi-functional gear lubricants.

Summarizing Discussion

It is not intended that the discussion given in this paper involves coverage of the many pertinent factors. Rather, it is intended only to illustrate by two or three specific examples, a general philosophy of approach that would take advantage of the splendid work carried out by the oil companies and other groups in the development of improved lubricants.

In considering the extent to which multi-functional lubricants can be employed to the over-all advantage of both the consumer and of the manufacturer and vendor of lubricants, it would seem that we should be realistic enough and frank enough to recognize certain important limitations regarding the state of our knowledge. We are listing several factors, each of which in our opinion should be kept in mind in considering the present situation with reference to lubrication engineering and possible future needs, and the role to be played by increasing availability and use of multi-functional lubricants.

1. To what degree is the customer or the consumer of lubricants familiar with at least the major elementary fundamentals of lubrication from the engineering, chemical, and manufacturing points of view? Obviously an uninformed consumer will be unable to utilize most effectively the knowledge and know-how built into the various lubricant products by the manufacturer of lubricants. Multi-functional lubricants tend to provide a safety feature in this regard.

2. To what extent is the oil supplier skilled in the particular problems of operation, production, and other phases of a given potential consumer? For example, in the Aluminum Company of America, we take the position that the performance of the lubricant will also be a function of metallurgical variables, production equipment, and associated production practices peculiar to our industry. These other factors are, in our opinion, just as important in determining the operating characteristics of a lubricant as are the properties of the lubricant itself. Again, the development and use of the most versatile lubricants possible would be of value in meeting the requirements involved.

3. To what extent are variations in operating conditions and associated factors likely to occur, and to what extent are these recognized and controlled? These variations in operating conditions representing a given application are, in our opinion, pertinent. They may represent variations of greater magnitude than the significant differences in a series of oils which might be under consideration.

4. Closeness of control of operating conditions has a logical relationship to the consideration of the use of multi-functional lubricants. An operation in which the operating temperatures of the oil, for example, may vary over a span of 25, where rubbing speeds may vary by a factor of several-fold, where unit or impact loads may likewise vary by many percent in effect constitutes a

multitude of different individual operating conditions. Therefore, best results should be obtained with a multi-functional lubricant.

5. The role or value of laboratory testing procedures in the selection and application of lubricants has been unduly criticized. Those who argue that selection of lubricants should be made on the basis of performance in the intended production equipment must certainly realize that a piece of production equipment, at best, is not a yardstick of constant and well defined properties. It is altogether too frequently possible to obtain a broad range of operating results even in a single machine element on different days and indeed on different hours and with different operators. Which one of these combinations of conditions shall be considered representative?

6. Interpretation of data obtained with laboratory bench type tests must necessarily be a function of experience, judgment, and knowledge. We have found in the course of our work that results obtained on laboratory machines which initially seemed to be highly contradictory, and bearing little practical relation to production conditions, actually make sense when interpreted in the light of later knowledge.

7. Initial cost of lubricant is not necessarily a reliable over-all criterion. Loss of a single complicated heavy duty machine element will pay for many thousands of gallons of oil. The engineer traditionally designs into his machine elements or other structures substantial margins of safety. It is considered proper in this case to increase the margins of safety in those instances where insufficient knowledge is available with regard to all factors. It is suggested that the lubrication engineer should approach many of his problems in the same manner. Where there is a question as to the exact needs with regard to lubrication properties, emphasis should be given to the selection and use of as versatile a lubricant as possible. The lubrication engineer should recognize that in spite of the great progress made in this field, we are still as "babes in the wood." It would be hard to cite any branch of technology which involves a greater number of variables simultaneously. Therefore, it would seem to be good sense, when in doubt, to use a lubricant capable of meeting the widest possible set of operating conditions.

The feasibility and merit of the approach outlined in this paper have been demonstrated to our satisfaction in the operations of our own Company. Although we have not had the space to present a detailed discussion, our experiences with the use of multi-functional greases is one of several outstanding examples. Our search for a number of grease products which would operate satisfactorily under as broad a range of operating conditions as possible has indicated that it will be entirely feasible to effect very substantial reductions in the numbers and types of grease products employed by us in the lubrication of grease lubricated elements. This would be possible as indicated through the application and use of grease products which in effect could be considered as multi-functional in their ability to lubricate satisfactorily under a broad variety of operating conditions. Of course, anything that can be done by the supplier to reduce the initial cost of such multi-functional products would be a powerful incentive to the broader use of such multi-functional products.

Perhaps we have all been guilty, to varying degrees, of taking the extent of our knowledge too seriously. When we learnedly discuss detailed differences in a multitude of physical, chemical, and "operating" characteristics of hundreds of different lubricant products, are we perhaps not taking a good deal for granted regarding the extent of our knowledge as to the inter-relationships between these lubricant properties and machine element design, operating variables, the human element, etc., etc.? The highly controversial nature of these problems is proof enough that we have yet much to learn. If we cannot agree among ourselves on a suitable procedure for evaluation of the oxidation stability of an oil, to say nothing of defining what we mean thereby, how can we precisely match this "property" to a set of widely fluctuating operating conditions?

Therefore, would it not seem to be the more sensible and realistic approach to refine and increase the variations in lubricant products, and precise matching of a lubricant to a given job only as progress in development of "science" in the "art" of lubrication clearly makes it possible and advantageous to do so? The role of multi-functional lubricants then assumes a useful place in current times. As such, it is of course necessary, for best results, to strive for the best possible balance between the goal of fewest number of lubricants and the specific requirements of each application.

In conclusion, we would like to comment on the tremendous outpouring of talent, effort, and money on the part of many of the oil producers and other groups in an all-out attack upon the mysteries of the art of lubrication. One has only to visit some of the representative research laboratories of the various oil companies to be greatly impressed by the tremendous effort involved. We are certain that this effort will be crowned with success and will be reflected by an increasing application of scientific principles in the selection and application of lubricants. However, we should like to suggest that in this regard the consumer be looked upon as a full partner and that he be encouraged in his selection and use of lubricants to become acquainted with the key basic scientific factors which determine the properties of the lubricant. The progressive consumer must know something more than the brand name of the lubricant item if he is to cooperate most effectively in advancing the science of lubrication.

As suggested elsewhere in this paper, a clear understanding of the inter-relationships between operating conditions, chemical and physical properties of a lubricant, and a net over-all performance of the lubricant, is a necessary pre-requisite to best over-all progress. We feel that each member of the team, namely the manufacturer of lubricants, the design engineer, and the consumer can make a special contribution to the over-all effort. This contribution will increase in value to the extent that each member of the team makes it his job to know as much as possible about the fundamental chemical, engineering, operating, and purchasing factors involved.

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APPLICATION OF WEAR RESISTANT PHOSPHATE COATINGS TO FERROUS SURFACES*

by M. B. Roosa
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M. B. Roosa received his B.S. degree in Chemical Engineering from the University of Michigan in 1936. Since that time he has been continuously employed by the Parker Rust Proof Company in the capacities of Research Chemist, Service Engineer, Eastern Region Manager, Assistant Technical Director, Service Manager and in 1947 was appointed Assistant Sales Manager. He is a member of the A.C.S., A.I.C., and N.A.C.E.

The automotive, aircraft and diesel engine fields have maintained one common trend, toward increased power output, higher compression ratios, with resultant higher engine temperatures. As a result the break-in and scuffing problems in engine design have become of prime importance wherever ferrous metals are used as bearing surfaces.

The problem of the lubrication engineer of maintaining an adequate and continuous oil film at all times on moving metal surfaces became greater with these basic engine improvements. Failure in this requirement meant excessive wear and galling of mating surfaces and was a point of principal concern to design engineers.

In approximately 1940, Parco Lubrite[1] was introduced to industry as a wear resistant product for use on ferrous surfaces. The treatment immediately met with wide approval, and when used in combination with well engineered lubrication readily became a proven method for reducing wear and galling on bearing surfaces.

Functions and Qualities of the Treatment Coating

The functions and qualities of this wear resistant and anti-galling coating can be understood more clearly when one has some knowledge of the chemistry behind the treatment and understands the nature of the coating produced. The treatment bath consists essentially of metal acid phosphates containing free phosphoric acid and accelerating media. When the properly cleaned parts are immersed therein, a coating of the phosphates of manganese and iron is produced on ferrous surfaces.

The crystalline, non-metallic and oil absorptive characteristics of the coating are highly beneficial as related to the problems of the design and lubrication engineers. There are, in the opinion of the writer, four important functions that this treatment coating performs in providing wear resistant and anti-galling properties as follows:

1. *Prevents welding of metals under load.* The treatment forms a chemical layer of an inert phosphate coating between mating surfaces, which acts as an anti-flux. In the formation of this coating there also occurs a preferential removal of ferrite, which is recognized as the constituent in iron which welds most readily.

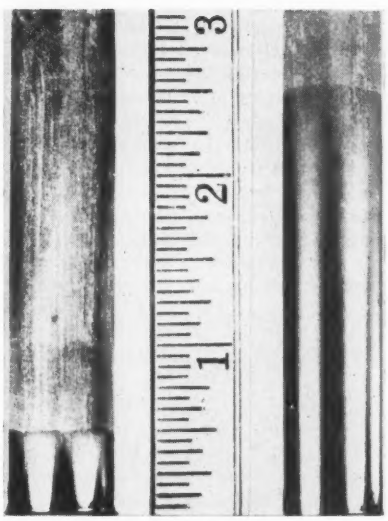


Fig. 1
Oil absorption by manganese iron phosphate coating. Left, untreated shaft; right, phosphate treated shaft.

2. *Increases lubrication efficiency.* The oil absorptive property of the coating assures an adequate and continuous oil film on bearing surfaces at all times.

3. *Assures rapid and safe break-in.* The finely crystalline and anti-welding coating brings about smooth bearing surfaces on mating parts by the removal of any high spots or microscopic irregularities. The mild polishing action of the coating acclimates parts to running together. Such surfaces after break-in contain an even and fine distribution of oil reservoirs, channeled and imbedded with oil absorptive phosphate coating.

4. *Removes chemically any irregularities occuring from machining operations.* The finely controlled acid reaction of the treatment bath removes by preferential attack, metal burrs, "wire edges," or any irregularities that may occur on the bearing surface.

These four primary functions of the treatment can be pictorially illustrated by photomicrographs of sample specimens. For example, Figure 1 clearly demonstrates the affinity of oil to the treatment coating. The shaft

[1] Parco Lubrite—Registered Trade Mark, Parker Rust Proof Company.

* Paper presented at 5th Annual Convention of A.S.L.E., Detroit, April 12, 1950.

on the left was untreated while the one on the right was treated, then both were placed on end in a shallow vessel of oil. It can be noted that in the same unit of time, the capillary action of the coating has caused the oil to be drawn up the treated shaft approximately five times farther than that of the untreated shaft.

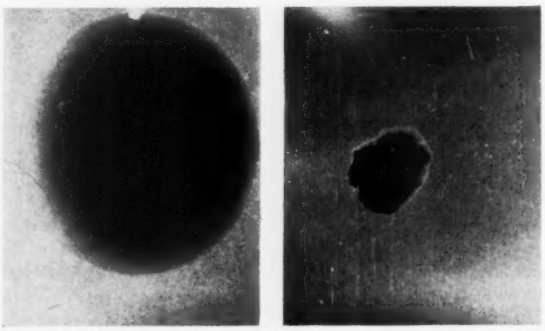
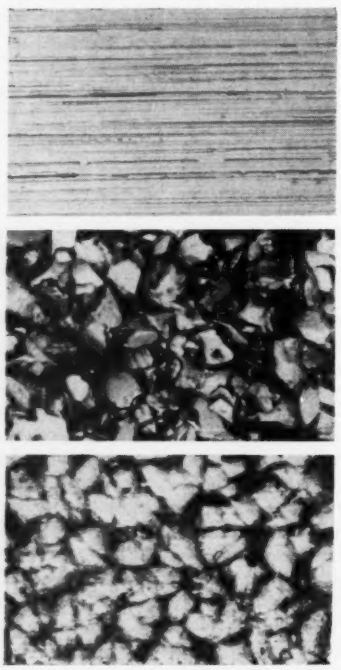


Fig. 2

Comparative spreading rate of a drop of oil on a phosphate treated steel surface, left; and an untreated steel surface, right.

Figure 2 demonstrates the increased oil wetting properties of the coating. Equal size droplets of oil were placed on horizontal steel plates, the one on the left treated and the one on the right untreated. The wetting tendency of the coating and its value over that of the untreated sample is clearly demonstrated by this illustration. These points should be of prime importance to lubrication engineers for it assures them that the lubricant will reach the remote areas of an assembly, and that a continuous oil film on moving parts will be provided at critical times of "break-in."

Photomicrographs at 100X showing the difference in:



A. A finished steel surface without treatment.

B. A similar surface coated with manganese iron phosphate.

C. A similar phosphate treated surface after coating removal by chemical means.

Fig. 3

In Figure 3 the photomicrographs of three steel specimens at 100 magnifications are shown. A, represents a finished steel surface without any benefit of treatment. You will note the finely defined lines of the machining operations with many irregularities in the surface. B, is a view of the same steel surface completely and uniformly coated with manganese and iron phosphates. It is this crystalline and oil absorptive coating which acts as an anti-welding medium in bringing about a smooth bearing surface during the initial run-in. C, is the same treated steel surface after the coating has been entirely removed by chemical means. This view shows the oil channeling effect and areas where phosphate coating would normally be microscopically imbedded in a part after break-in. This is conclusive evidence that the values of the treatment coating continue well beyond the period of initial run-in.

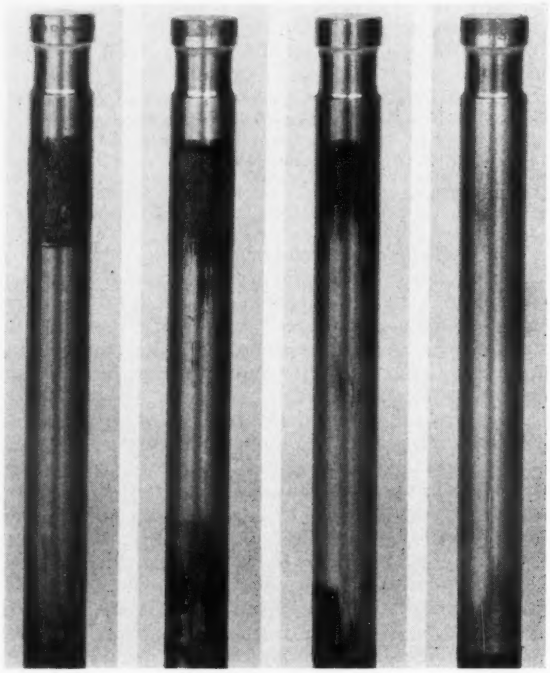


Fig. 4

A. 5 micro-inch finish valve stem.
B. 30-40 micro-inch finish valve stem. (Both run in an untreated burnished guide)
C. 5 micro-inch finish valve stem.
D. 30-40 micro-inch finish valve stem. (Both run in a rough reamed guide coated with manganese iron phosphate)

In Figure 4 the results of a research project on the finishing of valve stems and guides in relation to the phosphate coating treatment are illustrated. A manufacturer of valve stems investigated the effect on the wearing qualities of his product by varying the micro-inch finish on valve stems used in burnished and rough reamed guides. Valve stem A had a 5 micro-inch finish and was run in a burnished guide with no treatment. Definite scuffing was experienced. Valve stem B had a 30 to 40 micro-inch finish and was also run in a burnished finish guide with no treatment. The scuffing effect was still evident but less severe than with valve stem A.

In variation C the valve stem had a 5 micro-inch finish as in A, but was run in a rough reamed guide which had been given the phosphate coating treatment. A definite improvement was indicated over A and B with no scuffing, but heavy bearing marks were indicated.

The final variation D had a valve stem with a 30 to 40 micro-inch finish and was run in a rough reamed

guide which also had been treated. This variation proved to be the best combination and was accepted as the manufacturing standard. This research project not only pointed out the values of the treatment coating but also indicated that certain types of microscopic roughness were advantageous in preventing scuffing on initial run-in.

These four functions of the treatment are commonly recognized but there is also a property which is always present, namely, added rust resistance. The iron and manganese phosphate coating when saturated with oil offers considerable corrosion resistance and is a feature to be considered in the storage of parts or complete engines. Figure 5 shows a group of piston rings which were submitted to a salt spray test for 24 hours. The rings on the left were untreated and those on the right were phosphate coated, then both groups were oiled prior to submitting to test. It can be noted that the untreated rings show definite corrosion as compared to the treated rings which are still perfect. This feature is currently being considered as related to corrosion prevention on long time storage of aircraft engines.

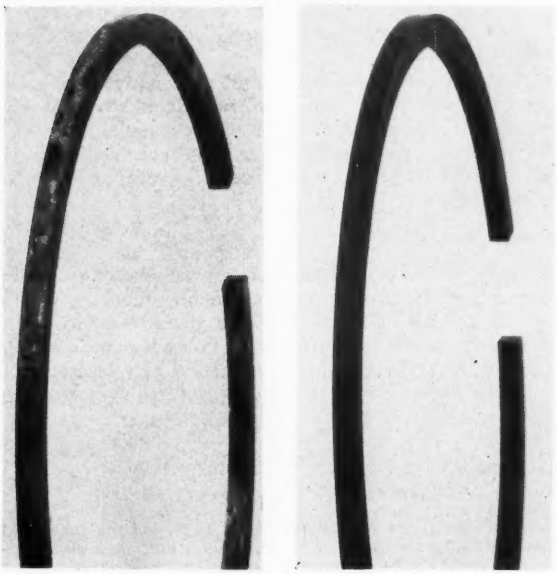


Fig. 5

Unretouched photographs of production piston rings received from piston ring manufacturer, oiled and submitted to 24-hour salt spray test. Left, untreated ring; right, phosphate treated ring.

Method of Application and Relation to Production Practices

The functions and properties of the treatment coating as previously discussed are controlled to some degree by the method of application. For this reason it seems desirable to devote some time to a discussion of this subject.

The most common sequence of operations for a typical installation by which the phosphate coating is applied is as follows:

1. Immersion clean in a solvent type cleaner at room temperature for five minutes.
2. Cold water spray rinse one minute.
3. Hot water immersion rinse one minute at 160 to 180 F.
4. Process in treatment coating bath by immersion for approximately 15 minutes at 205 to 210 F.
5. Hot water immersion rinse one minute at 160 to 180 F.
6. Immersion application of soluble oil one minute at 140 to 160 F.

The above cycle is typical of approximately 90% of the applications. For example, this same sequence of operations is used in full automatic equipment at the modern Kettering Engine Plant, Oldsmobile Division of General Motors Corporation, in the treatment of parts for the new Rocket Engine. A medium crystal coating with a finely controlled etch is produced on such component parts of this engine as camshafts, rocker arms, rocker arm shafts, valve lifters, valve guides, and bearing surfaces of the throttle linkage assembly.

However, there are instances where experimental work has proved that a different crystal structure coating is desirable or a greater degree of etch is beneficial. There are also applications where very close tolerances are involved which may require special cleaning and processing methods, or possibly mechanical lapping or burnishing operations after processing.

The coating structure and resultant build-up, as well as the degree of etch produced on the base metal, are dependent for the most part on the cleaning method used. Either alkali or acid cleaning prior to treatment produces a coarse crystalline coating with a deep etch of the base metal, and is used only in isolated applications. The automotive universal joint cross constitutes an example where this type of coating is required. In service, the universal joint cross is subjected to sudden and heavy unit loads which necessitates a surface that will not gall or wear excessively under these conditions. In cooperation with the process engineering group of a large automotive company, a research program was started to determine the type of coating and etch that would be most satisfactory for this service. After investigating many cleaning methods it was found that if the parts were cleaned in an alkali immersion cleaner of closely controlled pH prior to treatment, the required etch could be produced. When this cleaning cycle had been established in production practice, consistent and satisfactory coatings were produced with good laboratory tests and field results.

In contrast, cast iron pistons must have a fine grained coating with particular attention devoted to the ring grooves. On volume production the pistons are usually carried through a five stage full automatic installation consisting of a spray hot emulsion cleaner, spray hot water rinse, immersion phosphate coating bath, immersion hot water rinse, and immersion hot soluble oil. The emulsion cleaning medium conditions the surface of the cast iron pistons so that it promotes the formation of a fine grained coating in the phosphate treatment bath.

It was mentioned that special consideration must be given to applications where close tolerances are involved. The conventional and average treatment coating will account for a non-metallic build-up of approximately 0.00015 to 0.0003 inches per surface depending on the specified cleaning method used. Where tolerance specifications will not allow for this great a build-up, the depth of coating can be controlled either by chemical or mechanical means.

If tolerances allow for a build-up of only 0.0001 to 0.00015 inches this requirement can be met fairly well by adjustment of the acidity of the bath and by the use of metal activating agents in the treatment solution to produce a very fine and dense coating. This procedure is satisfactory in 90% of such applications.

However, when the allowable tolerance is less than 0.0001 inches, it is usually necessary to resort to some mechanical operation after treatment. For example,

refrigerator compressor pistons and connecting rods fall into this tolerance range and some manufacturers burnish the parts after treatment. Due to its friable nature, the coating lends itself readily to removal by hand burnishing operations. During the past war the pistons for fuel injector pumps on aircraft engines were individually hand lapped after treatment into their respective cylinders. Wrist pins in one automotive company are cast iron lapped prior to use. It should be stated that although the outer surface of the coating is removed by such operations, there still remains on the bearing surface, the finely controlled etch pattern imbedded with oil-absorptive phosphate coating.

The automobile industry has taken full advantage of the values of this phosphate coating method in the treatment of many items not heretofore mentioned, such as piston rings, gear shifter forks, differential gears including pinion side gears and worm gears, automatic transmission parts, valve guides, valve tappets, cylinder liners and various other parts.

Several automotive engine manufacturers use this treatment on the cylinder bores of their engines. Two methods of application are used which might be of general interest. In one, the block is thoroughly cleaned in a monorail three stage spray washer followed by an air blow-off. The block is then placed head down on a stationary jig which is suspended over the processing tank. By a series of pumps, fittings and piping, the treatment solution is pumped into the bore only and allowed to flow back into the tank proper through an overflow outlet. After treatment the blocks are thoroughly rinsed with hot water and the bore is then cast iron lapped with oil.

In the other application, the blocks are treated in a similar manner with the exception that the entire block is immersed in the processing bath rather than attempting selective treatment of the bore.

Diesel engine manufacturers have also made wide use of this wear resistant treatment for coating either the liners or pistons. In some instances the piston only is treated and is run against a honed cast iron liner. Other manufacturers have resorted to treatment of the cast iron cylinder liner used in combination with lead plated pistons. In this particular application, the treatment coating on the liner is burnished down prior to assembly to prevent pick-up of the phosphate crystals in the soft lead coating of the piston. Regardless of which component of the cylinder-piston assembly the individual manufacturer decides to treat, it is agreed that this proven treatment method offers this industry a means of reducing scuffing and assuring quick break-in on these costly engines. Some diesel engine manufacturers have extended the use of this treatment to include crankshafts, camshafts and rollers, horizontal engine piston rods, piston rings, accessory drive gears and many other miscellaneous parts.

Economics of Treatment

The diversification of products on which the treatment coating is used, from the small thrust washer in an automatic transmission to the large piston in a powerful diesel locomotive, clearly demonstrates its utilitarian value to industry. However, the usefulness of a treatment must also be considered from the economic standpoint as related to cost of application.

Fortunately it is an economical treatment and this one factor is responsible, in part, for its wide acceptance by industry today. In discussing the economics of a treatment, one must consider not only the cost per unit area for application, but he must also consider what this cost may bring about in possible savings. Those savings may be related to material costs, changes in manufacturing procedures and elimination of costly field failures.

As related to cost of chemical for treatment per unit of surface, it can be stated that production experience has shown that it cost approximately ½ cent to treat the average automotive piston, and less than 1 cent for the average axle assembly consisting of drive pinion, side gears, pinion mates, pinion mate shaft, spacer and washers. Burden and labor costs, which vary considerably in different areas, must be added to this chemical cost. One manufacturer reports that by the use of this treatment he has effected a 50% savings in the costs of manufacturing procedures and materials as previously experienced with copper plating, which was used extensively prior to the advent of the phosphate coating method.

Without exception the use of this wear resistant and anti-scuffing treatment has effected untold savings to manufacturers in the elimination of costly plant run-in or field failures. The average cost for repairing and replacing differential gear assemblies is from $10.00 to $15.00 per unit. If failures are many, the use of this surface coating method can readily bring about large savings.

In addition it has been found that many times galling and subsequent failure of parts could be entirely eliminated by this treatment where previously a redesign or a more costly material of construction was considered for the part in question. Such factors involve many hidden savings.

Summary

This accepted phosphate treatment when applied to ferrous metals, provides a non-welding medium which assures greater lubrication efficiency, and safe break-in of bearing or sliding surfaces. It offers the mechanical, automotive and lubrication engineer a simple and economical means for assuring a product of maximum quality and life service.

Discussion by Kenneth P. Borror

Metallurgical Dept., Spicer Mfg. Div., Dana Corp.

Mr. Roosa has given an excellent paper on the functional characteristics, the method of application and successful engineering uses of the chemically applied manganese iron phosphate coating. This information should prove invaluable to engineers who wish to use this coating to prevent scoring, reduce wear or both.

In 1946 we started a testing program to determine if the manganese iron phosphate coating could be applied to hypoid bevel axle gears to increase the scoring resistance of these gears. Using the road "bump" tests with which nearly all untreated gear sets could be readily scored, it was found to be exceedingly difficult and usually impossible to score the gear sets utilizing treated pinion gears mated with untreated ring gears. Fatigue tests for assembled axle units with treated pinion gears and untreated ring gears made on a "Gleason" machine indicated that the fatigue life was essentially unchanged. Hypoid gear sets with treated pinion gears regularly exhibited smoother mating surfaces and increased contact areas after running in. Figures 1 and 2 show a treated pinion and untreated ring gear set after a test run under the car. The smooth bearing surfaces and generous contact areas are clearly evident.

The etching action of the manganese iron phosphate processing bath results in a pitted condition on the base metal which continues to prove beneficial as a lubricant aid even after the surface layer is worn away. Figure 3 is a photomicrograph of a drive pinion gear tooth contact surface after being test run under the car. The microscopic pits are clearly exhibited at 100 diameters magnification.

The British, in a report by the Institution of Automotive Engineers, authored by H. D. Mansion, gave data showing that the load required to cause scoring for phosphate treated gears was double that required for untreated gears and that after

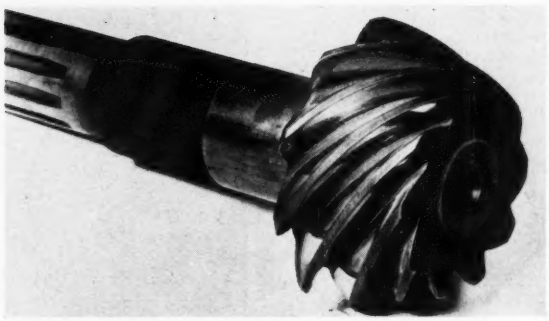


Fig. 1
Hypoid Drive Pinion—Phosphate coated—Road tested.

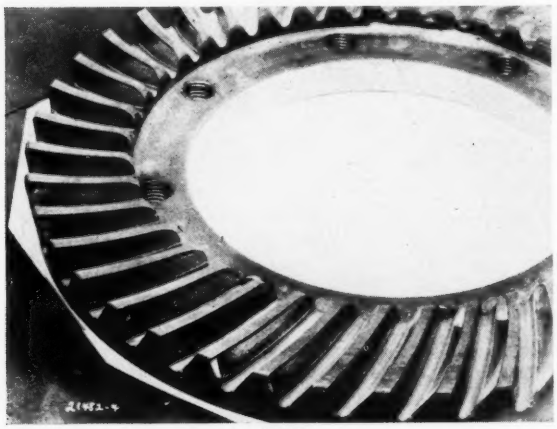


Fig. 2
Hypoid Drive Gear—Untreated—Road Tested—Mated with treated pinion.

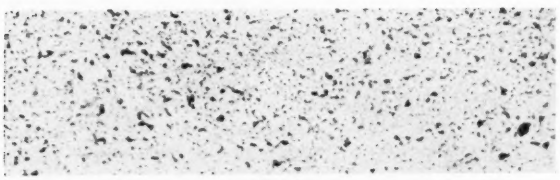


Fig. 3
Bearing area of treated Drive Pinion after test run under car—100X.

100 hours running-in at medium loads the scuff resistance was essentially unchanged. The coatings tested apparently were rather coarse since they resulted in a growth of from 3 to 4 ten thousandths of an inch on each surface.

Gears, bushings, shafts, journals, splined stub shafts and other mechanical transmission, torque converter and universal joint parts have been phosphate treated as an aid to lubrication and wear as well as for protection against seizure during breaking-in for well over ten years in our plants. In many applications it has made the difference between success or failure of the part on which it was used. This has been particularly true where seizure was troublesome.

There are several other applications entirely different from any of those mentioned that may be of some interest. In certain instances where difficulty has been experienced from breakage when driving studs or cap screws these parts were phosphate treated as an aid to assembly operations. In many cases breakage was entirely eliminated.

Certain gears which cannot be shaved, can be burnished by running them in the unheat treated condition against a hardened master gear which has been phosphate treated to obtain a relatively coarse granular coating on the gear teeth.

The uniformity of the coating can best be controlled when processing is done with machines, similar to plating units, utilizing automatically controlled time and temperature cycles. Small parts can be processed in tumbling barrels. At least one standard plating machine can be readily adapted to manganese iron phosphate processing with very little change except for the elimination of generators and adding of spray systems in some of the tanks. High production at very low costs are possible with a processing unit of this type.

Discussion by J. L. McCloud

Mfg. Research, Ford Motor Co.

Mr. Chairman, Members of American Society of Lubrication Engineers, Exhibitors and Guests:

Mr. Roosa's paper is an interesting discussion of applications of phosphate coatings for wear resistance.

We believe that it is quite important to bear in mind one of Mr. Roosa's introductory paragraphs; namely, that manganese iron phosphate coatings be considered in combination with well engineered lubrication.

It seems, from our experience, that one must not lose sight of the necessity in this application for the use of a reasonable quantity of oil. We have noted that where the surfaces, even though phosphate coated, are starved of oil, the beneficial effects no longer prevail. For instance, in the case of certain drives between a gear integral with a cast iron camshaft running against a cast iron gear for accessory drive, it was noted that use of certain types of oils, especially of low viscosity resulted in inadequate lubrication and bad scuffing occurred. It was in this instance possible by applying another metallic coating by electro deposition on one of the gears to enable this combination to function satisfactorily.

We have also noted that phosphate coating by itself may not suffice in some instances, and that the hardening of the mating steel surface may be a requisite to satisfactory operation.

On the other side of the ledger, a survey of the automotive field a year or so ago by Ford Motor Company personnel in conjunction with Parker Rust Proof Company and automotive suppliers, disclosed that proper application of phosphate coatings of the type being discussed was the difference between unsatisfactory and satisfactory operation during break-in where the best available lubrication appeared to be border line.

Examples were also noted where application of phosphate coatings in pump manufacturing made possible the use of stamped steel covers and floating or spacer plates with the steel in its "as rolled" state, without further heat treating or hardening. Phosphate coating of steel shafts and cast iron bearings eliminated the necessity of sleeve bearings in many cases. Coating of the shaft also increased the life of a spring loaded seal running on the shaft. In the case of valve rocker arms, the manganese iron phosphate treatment gave satisfactory operation of the malleable casting on an untreated shaft and replaced a bushing and copper plating of the shaft.

In Mr. Roosa's example of valve guide treatment, reduction in machining requirements is clearly demonstrated to produce a satisfactory combination. These examples all represent cases where increased cost of phosphate coating may be either partially or totally offset by material, machining or process savings. However, we believe, as Mr. Roosa points out, that savings to a supplier in reduction of field failures indicated by proper application of the phosphate coating cannot in many instances be figured in dollars and cents.

We believe that proper use of the manganese iron phosphate coatings in the automotive field for the past several years clearly demonstrates Mr. Roosa's claims to be well founded.

We do not believe that this process is presented as a "cure-all" for lubrication problems but rather as a technical tool for lubrication engineers as design requirements continue to make their job tougher.

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Mr. Roach is a Research Engineer with the Research Laboratories Division of General Motors Corporation. His work is primarily in the field of lubrication theory and journal bearing performance. He is a graduate of the University of Delaware (B.E.E.) and of Wayne University (M.S. in M.E.). He is a member of the Scientific Research Society of America, the Society of Sigma Xi, the Industrial Mathematics Society, Tau Beta Pi, Pi Mu Epsilon, and Phi Kappa Phi.

PUMPING CHARACTERISTICS OF AN 180-DEGREE JOURNAL BEARING*

by A. E. Roach

Research Laboratories Division
General Motors Corporation
Detroit, Mich.

Although the ability of a journal bearing to function as a pump when a hole is drilled through it into the high-pressure oil film was observed as early as 1883 by Beauchamp Tower,[1] this aspect of bearing operation appears to have subsequently attracted little interest. The use of a bearing as a pump might be attractive, however, in special instances where a small quantity of high-pressure oil is desired but where it is not economically feasible to install a separate pump; pumping duty might then be imposed as an additional duty upon an existing bearing. The suitability of the scheme would depend (1) on the pumping characteristics of the bearing and (2) on the effect that the pumping duty would have on the bearing's performance as a load-carrying member. Since definite information on these points was lacking in the literature, some tests were carried out to explore the scheme and to evaluate in a general way the effect of the operating variables of the bearing on its pumping performance.

Before presenting the results of the tests, we may review briefly the essential facts relating to the development of oil-film pressure in journal bearings. The pressure of the oil film in a bearing builds up in the general manner indicated by the solid line in Figure 1. The average pressure of the oil film is numerically equal to the unit load on the bearing, while the peak pressure of the oil film exceeds the average pressure by an amount which is a function of the length-to-diameter ratio of the bearing, the eccentricity ratio of the journal, and the extent of the oil film.[2] Under extreme conditions the ratio of peak-to-average pressure has been reported[3] as high as 27 to 1; for normal conditions a value of between 3 to 1 and 5 to 1 would be reasonable.

If the bearing surface is interrupted by a hole in the high-pressure region, oil will flow out of the bearing, and the bearing will act as a pump. If the outflow is unrestricted, the oil-film pressure will fall to atmospheric at the hole, as indicated by the dashed line in Figure 1. If the outflow is restricted, the oil-film pressure at the hole will have some intermediate value.

An 180° journal bearing was run to investigate the above effect. The bearing measured 3 inches long by 1.5 inches in diameter and had an axial oil-collecting groove of 15/16 x 1/8 inch located 10 degrees off center toward the high-pressure region.

Figure 2 shows the general arrangement of the apparatus. The test bearing (A) rested on a short journal which was supported by pillow blocks (B) and belt-driven by means of a direct-current motor. Lubrication

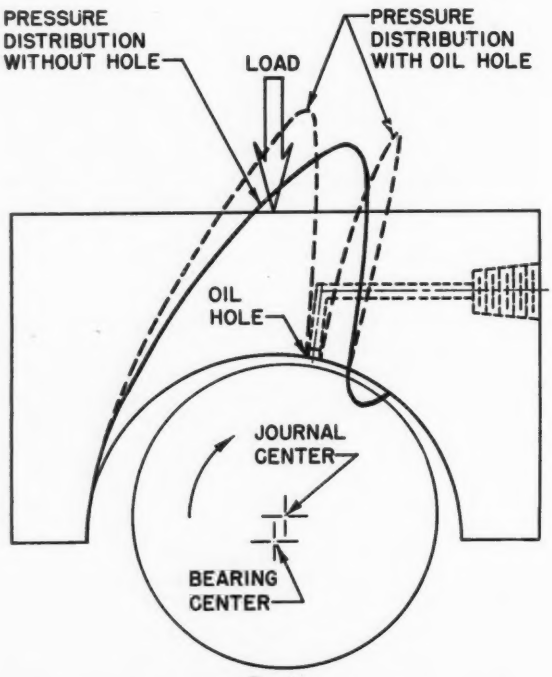

Fig. 1
Distribution of oil-film pressure in 180-degree journal bearing. Solid line indicates pressure distribution with oil hole stopped. Dashed line indicates pressure distribution with oil hole open.

was supplied from an oil bath (C). The bearing was loaded through a ball-and-socket joint by means of the lever (D) from the end of which weights (E) were hung. Oil was bled from the bearing through the needle valve (F) and was collected in a graduated cylinder (G). The discharge pressure of the oil was indicated by the pressure gage (H).

Typical pumping performance curves for this bearing are shown in Figure 3, which is a plot of the capacity in milliliters per minute (1 ml = approx. 0.061 cubic inch) as abscissa versus head in pounds per square inch as ordinate for various journal speeds in revolutions per minute. No attempt was made to maintain

* Presented before the Detroit Section of A.S.L.E.

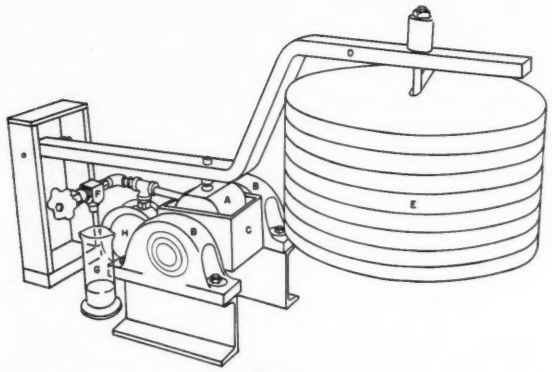

Fig. 2

Arrangement of apparatus.

uniform temperature of the oil bath, the temperature varying in these tests from 138 F. to 165 F. However, as shown by Figure 4, which is a plot of the oil-bath temperature in degrees Fahrenheit as abscissa versus capacity in milliliters per minutes as ordinate for a constant journal speed of 1600 revolutions per minute and a constant head of 100 pounds per square inch, the effect of temperature variation in this range was not marked.

The influence of the principal operating variables on the capacity of the bearing-pump was found from a number of runs under various conditions of journal speed, bearing load, discharge pressure, clearance, groove length, groove location and viscosity to be as follows:

A. Journal Speed—The capacity varied almost directly as the journal speed, all other factors being held constant. See Figure 3.

B. Bearing Load—The capacity was appreciably increased by increase in load at the higher heads. At the lower heads, when the delivery was relatively unrestricted, increase in load had negligible effect on the capacity.

C. Clearance — The capacity was approximately doubled when the clearance was increased from 0.002 to 0.005 inch. Further increasing the clearance from 0.005 to 0.008 inch caused the capacity to be slightly decreased.

D. Viscosity—The capacity varied with viscosity in the manner indicated by Figure 4. Viscosity and film thickness are closely related, and it is probable that the increase in capacity with increase in viscosity is due primarily to the increase in film thickness that accompanies it. At the same time, increase in viscosity causes an increase in the resistance of the discharge system so that, as shown by Figure 4, there is an optimum viscosity at which the film thickness and resistance to flow in the discharge system are ideally balanced.

E. Head—The capacity varied inversely as a function of the head, the effect being more pronounced at high journal speed than at low. See Figure 3.

F. Groove Length — The capacity was approximately doubled over most of the range of heads tested by increasing the length of the oil-collecting groove from 15/16 inch to 1-15/16 inch.

G. Groove Location—The capacity was slightly increased when the groove was moved forward of the high-pressure region by reversing the direction of journal rotation. This effect is probably due to the greater film thickness ahead of the high-pressure region.

In the application of small high-pressure pumps a point of interest is sometimes the ability of the discharged fluid to perform work on a piston or rotary positive-displacement motor. The work capacity, or power output, of the pump is proportional to the product of the head and the capacity. Figure 5, which presents the capacity in milliliters per minute as abscissa versus power output in foot-pounds per minute as ordinate for various values of constant journal speed in revolutions per minute, is a typical power-capacity plot for the bearing-pump. The dashed lines radiating from the origin are lines of constant head.

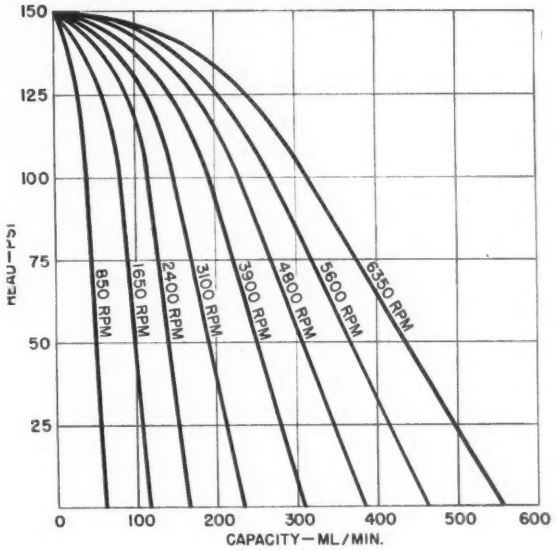

Fig. 3

Pumping characteristics of 180-degree journal bearing. Length = 3". Diameter = 1.5". Load = 89 psi. Clearance = 0.005". SAE 30 oil at 138-165 F. Oil-collecting groove = $1\frac{5}{16}$x$\frac{1}{8}$", located 10° off-center in high-pressure direction.

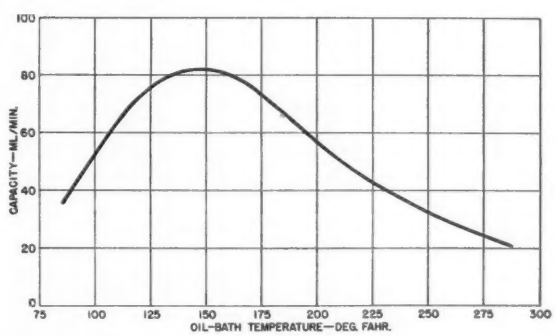

Fig. 4

Variation in capacity with variation in oil-bath temperature. Same bearing as in Fig. 3. Load = 89 psi. Pumping head = 100 psi. Journal speed = 1600 rpm. SAE 30 oil.

Since the power output is proportional to the product of the head and the capacity, it follows that the effect of the operating variables of the bearing on its power output is in the same direction as their effect on the capacity, when the head is held constant. When the head is allowed to vary, it is found that there is an optimum head at which the power output is a maximum for any journal speed. For the test conditions shown, this optimum head was constant at about 112 pounds per square inch. In other runs there was some indication that the optimum head tended to increase very slightly with increase in journal speed.

No measurements were made of the actual friction

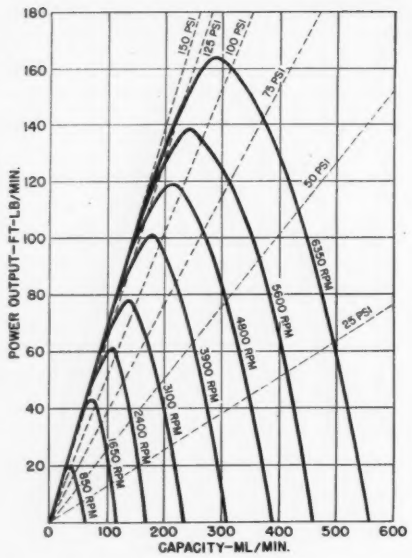

Fig. 5

Power-capacity characteristics of 180-degree journal bearing. Same bearing and running conditions as in Fig. 3.

torque on the bearing. However, the relative friction torques when pumping and not pumping were determined by measuring the electric current input to the driving motor. In the range of conditions tested, it was found that the increase in bearing friction due to pumping duty did not exceed one percent. Examination of the bearing showed no evidence of film breakdown or surface contact. The load conditions were, however, quite mild, in no case exceeding 100 pounds per square inch.

It is perhaps worth noting that the very light loads employed in the tests did not necessarily enhance the pumping efficiency of the bearing. Indeed the contrary would appear to be the case, as may be shown by the following considerations. Holding all the primary operating conditions constant except the unit load, it may be seen from Petroff's law that the product of the unit load and the friction coefficient will tend to remain substantially constant. Hence the power input to a given bearing running at a given speed will tend to remain substantially constant as the unit load is varied. The power output, on the other hand, is proportional to the product of the head and the capacity, and since the head is a function directly of the unit load, the power output with constant capacity will tend to increase with increase in the unit load. The pumping efficiency then tends to vary directly as the unit load, so that the higher the unit load, the more efficient the bearing-pump.

The question might be asked: How can we utilize the foregoing experimental results in designing a new bearing pump which is required to satisfy head and capacity requirements substantially different from those which we have heretofore considered? A possible solution to this problem may be obtained by utilizing affinity relations obtained from dimensional analysis, a method of analysis which was first applied to lubrication problems by Hersey.[4]

The method entails two important restrictions. We are restricted to dealing (1) with geometrically similar bearing-pumps and (2) with dynamically similar flows.

The restriction of geometrical similarity means that we are permitted to deal only with bearings all of which have the same length-to-diameter ratio, the same clearance-to-diameter ratio, and so forth. The restriction of flow similarity means that we are obligated to satisfy the criterion for dynamically similar flows. This criterion, as well as the pertinent affinity relations, may be derived by dimensional analysis.

Neglecting geometrical factors, we have found that the capacity Q of the bearing-pump is a function of the viscosity μ of the lubricant, the unit load p of the bearing, the head H developed by the bearing, the speed N of the journal, the scale D of the bearing. Writing this in functional form, we have

$$Q = f(\mu, p, H, N, D) \quad \ldots\ldots (1)$$

Assuming that we can express the functional relationship between these variables as closely as we desire by means of a power function, we may rewrite Eq (1) as

$$Q = K \cdot \mu^a \cdot p^b \cdot H^c \cdot N^d \cdot D^e \quad \ldots\ldots (2)$$

in which K is an unknown coefficient and a, b, c, d and e are unknown exponents.

Eq. (2), if physically correct, must be dimensionally homogeneous. Rewriting Eq. (2) in dimensional form, we have

$$[L^3T^{-1}] = [FL^{-2}T]^a\,[FL^{-2}]^b\,[FL^{-2}]^c\,[T^{-1}]^d\,[L]^e \quad \ldots\ldots (3)$$

If this equation is dimensionally homogeneous, the sums of the exponents of each of the dimensions on one side of the equality sign will be equal to the sums of the exponents of the corresponding dimensions on the other side. Solving for the unknown exponents, we have

For F, $0 = a + b + e$
For L, $3 = -2a - 2B - 2C + e$
For T, $-1 = a - d$

from which it follows that $b = -a - c$, $d = a + 1$, and $e = 3$. Substituting these values in Eq (2), we have

$$Q = K \cdot \mu^a \cdot p^{-a-c} \cdot H^c \cdot N^{a+1} \cdot D^3 \quad \ldots\ldots (4)$$

We may collect together terms with similar exponents:

$$\frac{Q}{ND^3} = K \cdot \frac{\mu^a N^a}{P^a} \cdot \frac{H^c}{P^c}$$

Rewriting this in functional form, we have

$$\frac{Q}{ND^3} = f\left(\frac{\mu N}{P}\right) \cdot \phi\left(\frac{H}{P}\right) \quad \ldots\ldots (5)$$

We cannot determine the form of the unknown functions f and ϕ from dimensional considerations alone, but we know that for geometrically similar bearing-pumps with dynamically similar flows, f and ϕ will be invariant. We may, therefore, write, for geometrically similar bearings, denoted by the subscripts 1 and 2,

$$\frac{Q_1}{N_1 D_1^3} = \frac{Q_2}{N_2 D_2^3} \quad \ldots\ldots (6)$$

$$\frac{H_1}{P_1} = \frac{H_2}{P_2} \quad \ldots\ldots (7)$$

$$\frac{\mu_1 N_1}{P_1} = \frac{\mu_2 N_2}{P_2} \quad \ldots\ldots (8)$$

Eq (8) is the criterion for flow similarity. When Eq (8) is satisfied and the bearings are geometrically similar, then Eqs (6) and (7) also hold, and the per-

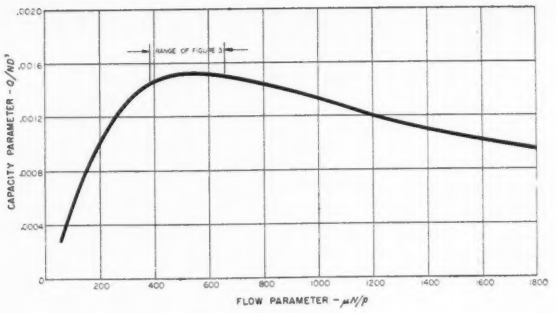

Fig. 6

Variation in dimensionless capacity with variation in flow parameter. Same operating conditions as in Fig. 4.

formance of an unknown prototype (subscript 2) may be predicted from the experimentally determined performance of a model (subscript 1).

The parameter $\mu N/p$ influences the fluid friction of the system. In addition, hydrodynamic theory teaches us that $\mu N/p$ also influences the film thickness and pressure distribution in an oil-film bearing; hence, $\mu N/P$ becomes an additional criterion for geometrical similarity. Inspection of Figure 3 suggests that the effect of $\mu N/p$ on the capacity of the bearing-pump was only slight in the range tested, since the capacity was found to vary nearly as the journal speed. This is further shown by Figure 6, which is a replot of Figure 4, with $\mu N/p$ (centipoises-rpms/psi) as abscissa versus Q/ND^3 (milliliters per minute/rpms-inch^3) as ordinate.

The value of $\mu N/p$ in the experiments is most conveniently expressed in terms of the journal speed; that is to say, for the data of Figure 3, $0.24\ N < \mu N/p < 0.41\ N$, in which μ is the viscosity in centipoises, N is the journal speed in revolutions per minute, and p is the unit load in pounds per square inch. This corresponds to the marked range in Figure 6.

In conclusion, the experiments indicate that a journal bearing can be operated as a pump without impairing its performance as a bearing. For such duty, it is, of course, essential that the bearing be generously proportioned with a large factor of safety. The performance is not of such a character as would lead one to select a bearing-pump in preference to other types of pump when this was the only duty imposed on the unit. The natural field of application would rather be in special situations where pumping service could be imposed as a secondary duty on an existing bearing which is also performing its primary duty as a load-supporting member.

The author is indebted to Messrs. J. F. Hagen and F. E. Heffner for assistance in making the experiments, to Messrs. J. H. Brems and N. A. Hunstad for comments regarding the dimensional analysis, and to Mr. A. F. Underwood, at whose suggestion the work was undertaken, for permission to publish the paper.

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(3) Stanton, T. E., "Friction," Longmans, Green & Company, Ltd., London, 1923, pp. 101-110.

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Discussion by John G. Wright

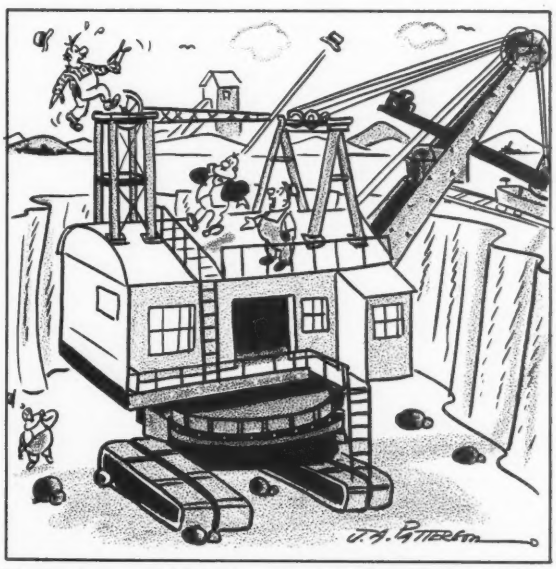
Dept. of Mech. Engrg., Wayne University, Detroit, Mich.

The paper as a whole, and especially the head-capacity characteristics obtained for the journal bearing, is very interesting. At low speeds of operation the pump exhibits characteristics of a positive displacement pump, whereas at the higher speeds the characteristics appear somewhat similar to those of a centrifugal pump. However, the nature of the characteristic should not be detrimental at all to the bearing's function as a pump.

Although interesting theoretically, the question arises as to the possible utility of this combination bearing-pump. The principal advantage, of course, is that it serves a dual purpose and thus eliminates a separate oil pump. This advantage would be of particular importance if there were severe space limitations.

Two of the more apparent possible applications are (1) the circulation of lubricating oil under pressure to other journal bearings, and (2) the circulation of lubricating oil, perhaps through an oil cooler, to facilitate cooling. With either of the above applications, when operating at constant speed, an increase in bearing load would result in an increased rate of circulation of lubricant. This is an advantage not possible with a positive displacement type pump.

However, the bearing, in order to function as a pump, must be located in an oil bath. This might not always be possible or desirable. Also, the bearing must be sufficiently large to provide the desired circulation of lubricant and still perform its primary duty as a load supporting member. Thus in many instances, in order to use a journal bearing as a pump, it would be a matter of putting primary emphasis on pumping duty rather than on load carrying ability, in which case a separate pump might be the better choice.



"Yardley is a good lubrication man—but he's got a bad habit of stepping back to admire his work7"

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ASLE ANNUAL AWARDS

The Captain Alfred E. Hunt Memorial Medal established in commemoration of the memory of Alfred E. Hunt, Aluminum Company of America, was awarded to William M. Schuck, Armco Steel Corporation, for the best paper relative to lubrication offered during the year.

Mr. Schuck's paper, entitled "Planning a Steel Mill Lubrication Program", will serve as an incentive to greater care in the selection and application of lubricants. It will also act as a stimulus to management in delegating more responsibility to the plant lubrication engineer.

The A.S.L.E. Annual Award, signifying life membership in the Society for the individual contributing most to the furtherance of the science and practice of lubrication, was presented to Lawrence G. Benton (retired), E. I. Du Pont de Nemours & Co., Inc.

Mr. Benton blazed a trail for the lubrication engineers more than fifty years ago. His untiring efforts in promoting practical application of the theory of lubrication, resulted in his successful organization of one of the first formal lubrication programs in American industry.

KETTERING SPEAKS!

"BOSS KET" needs no introduction to our readers. Attendance at the banquet which was the largest in our history, testified to Mr. Kettering's popularity and acknowledged ability. The "Boss" was in his usual good form. He commented seriously on the advance in lubricants and lubrication practice, with humorous allusions to some of our "past" and "pet" theories.

Giving an interesting account of his own experience with the industrial development of the past fifty years, he brought out the process of gradual change in railroad power from steam to diesel and the important part that lubrication has played in the development of all transportation and machinery. He outlined many of the obstacles that had to be overcome in paving the way to greater mechanical operating efficiency.

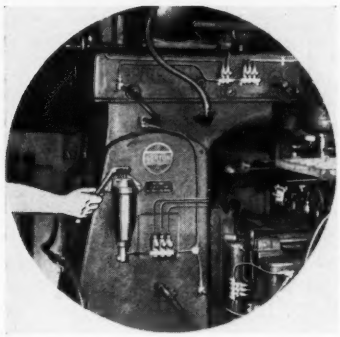
Mr. Kettering's contribution to our Fifth Anniversary banquet made it an occasion which will long remain with us.

LAWRENCE G. BENTON

WILLIAM M. SCHUCK

FIFTH ANNIVERSARY A.S.L.E. BANQUET, HOTEL STATLER, DETROIT, APRIL 11, 1950

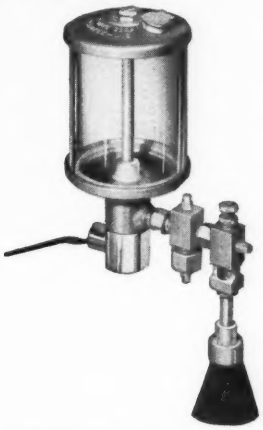
NEW PRODUCTS and EQUIPMENT



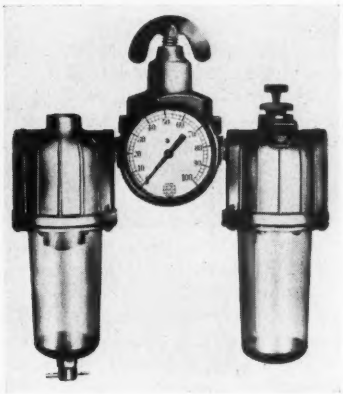
CentrOiler: Lincoln Engrg. Co., 5743 Natural Bridge Ave., St. Louis 20, Mo.—It is said this oiler may be installed on any machine tool to lubricate a multiplicity of bearing points. The system consists of the Centr-Oiler pump supplying a lubricant through a single line circuit of injectors which, in turn, deliver a predetermined, measured quantity of oil to each bearing every time the system is cycled. For complete information, write for Bulletin 802, address above.

Steel Drum Cutter: A. Schinker Mfg. Co., 6514 S. Western Ave., Chicago 36, Ill. — A head cutter, manually operated, that cuts the head of any size drum, is introduced by the above company. It is claimed that the cut leaves no ragged edges, with the metal flanging slightly inward. It is portable and weighs 36 lbs. Suitable for drums of all sizes. For further details, write the manufacturer.

Acheson Pamphlet: Acheson Colloids Corp., Port Huron, Mich.—This 4-page bulletin deals with colloidal graphite as an additive to industrial lubricants. It also discusses methods of blending, means of calculating dilutions, advantages of heating during blending and recommendations for applications in a variety of cases. This is available without cost by writing the above company.



Chain Oiler: Oil-Rite Corp., 3428 S. 13th St., Milwaukee 15, Wisc. — After satisfactory results on field testing, a new chain oiler is offered by the above company for the automatic lubrication of conveyor chains. It is gravity fed, with a solenoid operated valve, to a 2″ brush which rides the chain. Lucite or glass reservoirs available in six sizes ranging from 9 oz. to 1 gal. For further details, write the above company.



Airlube Unit: Airlube, Inc., 3422 W. North Ave., Chicago 4, Ill. — The dual control system combines two basic sections with a common regulator and gauge. One control, the Goodyer Pur-o-fier, is designed to remove oil, moisture and dirt from air and gas lines; the other, the Goodyer Pur-o-luber, provides finely atomized lubrication for air lines. Both are available for operation as separate units. Further information may be obtained by writing Mr. James G. Murdock, Sales Mgr. of the above company.

Filter Element: Letraw Mfg. Co., 229 W. Illinois St., Chicago 10, Ill. — This company has developed a new process of knitting wire mesh for use in the filter elements it furnishes. It is claimed that a greater uniformity of distance between threads aids in more even performance in filtration. Write the above company for additional information.

Fiske Bros. Announces: Lubriplate Division of Fiske Bros. Refining Co., 129 Lockwood St., Newark 5, N. J. —The new 44-page data book No. 1-50 has just been released. It contains valuable information on the subject of lubrication and should be of particular interest to those in charge of operation and maintenance.

Gravity Feed Oiler: Trico Fuse Mfg. Co., 2948 N. 5th St., Milwaukee 12, Wis. — It is claimed that with the new ratchet control mechanism, instant adjustment of the oil feed is possible. The spring mechanism locks the adjustment into position. The oil supply is clearly visible through a reinforced plastic reservoir. Available in from 1 oz. to 8 oz. capacities. Complete descriptive information given in Bulletin 26-X will be supplied without charge.

NEWS OF THE SECTIONS

Welcome to New Sections

CINCINNATI

There has been a recognized need for a Section in Cincinnati, which, up until the present time, has been served by the Dayton Section. On March 28th, through the fine cooperation of the Dayton group, who held their regular meeting at the University of Cincinnati, a new Section was established. Of the 50 people present, 30 were from the Cincinnati area.

Following the technical portion of the meeting (which is described under News of the Dayton Section elsewhere in these columns), Mr. W. F. Leonard, National Secretary, conducted an organization meeting. The group in attendance voted unanimously in favor of the formation of the Cincinnati Section. The election of Officers took place. (See Section Officers' page.) It was voted that immediate steps be taken to apply for affiliation of the new Section, with the Cincinnati Scientific and Technical Societies Council.

The first regular meeting is scheduled for the middle of May, with plans for Mr. C. L. Pope of Eastman Kodak Co., as the speaker.

Cincinnati, as a machine tool center, offers an excellent field for A.S.L.E. activities and there is a fine nucleus of members on which to build.

CHICAGO

Dr. M. Eugene Merchant, Senior Research Physicist of the Cincinnati Milling Machine Co. and Mid-Western Vice President of A.S.L.E., presented "The Action of Cutting Fluids in Machining," in March. Dr. Merchant is thoroughly familiar with this subject and his presentation, accompanied by a film illustrating the progress of the cutting tool through the piece, was most instructive. At the conclusion of Dr. Merchant's talk, there was a lively interchange of questions and answers.

Mr. Albert A. Raimondi, Research Engineer, Lubrication Section, of the Westinghouse Research Laboratories, spoke on the subject of "Principles of Lubrication," at the April meeting. Dr. Raimondi used models to illustrate the formation and maintaining of the oil wedge. He followed this demonstration with a film on the same subject but more extensively illustrating the points he brought out.

KINGSPORT

Sixteen members of the A.S.L.E. and guests attended the meeting on March 28th at the Kingsport Inn for the purpose of forming a local Section. Mr. W. S. Moorehouse served as temporary Chairman. A Nominating Committee was selected and the slate of Officers presented. The election was unanimous. (See Section Officers' page.)

Local industry has wholeheartedly approved the formation of this local group. Kingsport will draw members from the eastern Tennessee, southwestern Virginia and North Carolina areas. Indicative of industrial interest were representatives, at this first meeting, from such companies as Tennessee Eastman Corp., The Mead Corp., Esso Standard Oil Co., Blue Ridge Glass Corp., Borden Mills, Inc., and Kingsport Press, Inc.

This potential serves as a stimulus to a healthy and active Section.

Arrangements are now being made for a June meeting. Mr. S. E. Abernathy was elected as Program Chairman, and a sizable increase in membership is predicted by the Secretary, Mr. Jorgenson, before the June meeting.

We are sure the endeavors of our wide-awake members in Kingsport will augur well for a highly successful Section.

LOS ANGELES

The subject of the March meeting on power transmission and conveyor equipment was presented by Mr. M. J. Erisman, Chief Engineer of the Link Belt Co. in Los Angeles. Mr. Erisman has had over 15 years of practical experience on this subject. His talk on lubrication pertained to his company's equipment. Former Secretary Perso's excellent digest follows:

"Mr. Erisman mentioned that there is no common language which can be applied to lubrication of their equipment. However, he felt that a lubricant must do the following:

"1. Replace friction and reduce wear.

"2. Flush out old grease and replace with new, especially with materials-handling equipment such as conveyor belts, etc.

"3. Act as a cooling medium.

"He cited that bulk material handling equipment usually is tailor-made to meet particular needs.

"He distributed A.G.M.A. sheets and Link Belt's recommendations which are based on these sheets.

"Slides were shown covering information on: Silent Chain Drives, Herringbone Reduction Gears, Worm Gears, and PIV Vari-Drives and Pillow Block Bearings. Each type of unit was discussed as to its function and lubricant requirements. A motion picture was run which illustrated typical installation of Link Belt equipment, featuring primarily application of their conveyor belts."

For the new slate of Officers elected, see Section Officers' page.

"Heavy Duty Engine Bearings," by Mr. A. B. Willi, Jr., Assistant Chief Engineer of the Federal-Mogul Corp., Detroit, was the theme of the April meeting. Mr. Willi has had a long association with bearings and bearing problems. His discussion included the composition and characteristics of bearing metals, bearing installation and proper fitting, correct application, service problems and failures, and proper lubrication. In thus covering the wide range of information on the subject, whatever one's interests—whether they be concerned with lubrication design, manufacture or operations—the talk met everyone's needs.

DETROIT

The annual trophy to the Section obtaining the greatest increase in membership percentagewise from April to April, was presented to Detroit at the recent Convention in that city. Mr. E. D. Harkins, Chairman, received the trophy. Much of the success of our recent meeting was due to the loyalty, hard work and long-range planning of the Officers and Committees of this Section. The National office, as representing the entire membership of A.S.L.E., tenders a vote of thanks to our Detroit group.

Election of Officers was held at a recent meeting. (See Section Officers' page.)

INDIANAPOLIS

New Officers were elected for the coming year. (See Section Officers' Page.)

Mr. R. F. McKibben of the National Cash Register Co. presented a very informative talk on the methods, tests and supervision used in his laboratory in maintaining at optimum efficiency their large volume of hydraulic oils. Mr. McKibben's talk was well received and the practical information was appreciated by all those present.

BUFFALO

Mr. W. C. Lockwood of The Texas Co. gave a very impressive talk on two- and three-purpose cutting oil. The attendance in March was one of the highest this Section has had, and the subject was most interesting.

PITTSBURGH

The March meeting was the largest in attendance this Section has ever had. A total of 90 were present at the technical session. Mr. Charles E. Pritchard of Republic Steel Corp. spoke on "Steel Mill Lubrication." The slides portrayed the proper approach to the handling and applying of lubricants. Numerous questions were asked and a rising vote of thanks was given to Mr. Pritchard.

In lieu of the regular monthly meeting, a tour was arranged of the Irvin Works, Carnegie-Illinois Steel Corp., Dravosburg, Pa., for April. This is one of the largest tin mills in the country. During the tour, various lubrication problems were explained, and it was considered a very successful and instructive experience.

FORT WAYNE

A joint meeting with the A.S.M.E. was held in April. Mr. Fayette Leister, who is a graduate in Mechanical Engineering from the Drexel Institute of Philadelphia, was the speaker of the evening. He is Vice President in charge of Engineering at the Fafnir Bearing Co., and has served on various subcommittees of Annular Bearing Engineers Committee. He was a recent delegate to the ISO Conference in Paris. This was a most interesting evening with A.S.M.E.

BALTIMORE

Submitted by Mr. V. A. Ryan, Director of A.S.L.E., and Chairman of the Committee on Programs and Meetings of the Baltimore Section.

"Our Spring Season has been brought to a very gratifying completion. It consisted of two outstanding papers which brought out a total attendance of 113 members and guests.

"In March, Mr. L. J. Collins, Division Engineer, Gear Engineering Division, General Electric Co., West Lynn, Mass., presented a paper on 'Developments in Gear Design and Their Lubrication Requirements.' His introductory phase was devoted to a thorough description of the 'hill and dale' theory of surface finish and the effects of interlocking asperities on coefficient of friction, heat generation, wear and ultimate seizure and led up to the conclusions that, as a general rule, 'the better the surface finish, the more load a set of gear teeth will carry,' and that, 'at the present time it is not economically possible to produce gear teeth with ideally perfect finish and so we are confronted with interference between the surface imperfections. During the initial breaking-in period some of the imperfections will be sheared off even though the surfaces are lubricated.'

"The bulk of the talk then proceeded through a series of graph-illustrated tests on several gear sets at varying loads with lubricants of different viscosities. The results of the tests very definitely showed that 'if a tooth surface can be finished to a very high degree, load can be applied until the teeth break out. Under these conditions the oil film will not fail regardless of the viscosity of the oil.' In substantiation of this statement, Mr. Collins went on to say, 'we have loaded several gears until the teeth broke out from fatigue and there was no indication of a lubrication failure. You may be interested to know that the surface stress under these conditions was 250,000 p.s.i. and the oil viscosity was 40 s.s.u. at 100 F.' The net result of all the tests shown was the conclusion that, when a unit is running at a given load and a constant temperature, the oil film is separating the tooth surfaces, When the load is increased, oil is squeezed out and the load is then carried on a surface covered with imperfections. The oil film is then not thick enough to prevent shearing of the hills and heat is generated.

"The final portion of the talk covered the present trend in gear design and manufacture which, as Mr. Collins said, 'is to produce gears which are smaller in size and lighter in weight than they have been in the past. To accomplish this end, gear teeth will have to operate at much higher surface stresses. For example, where we have used a surface stress of 65,000 p.s.i., we would like to double or triple this value. Thus far we do not know how to produce gears so smooth that no lubricant will be required. In an effort to render the tooth surfaces as smooth as possible we resort to refining methods such as lapping, grinding, shaving and burnishing.' He then concluded by outlining what is desired in a gear lubricant for the gears of the future: (a) one which will prevent rusting; (b) one which will reduce the breaking-in period and help produce a finer surface finish; (c) one which will be low in viscosity to reduce losses and yet be able to withstand 200,000 p.s.i.; and (d) one which will wet the surface of a polished gear tooth even at very low speeds.

"At the April Meeting, the co-authored paper, 'The Lubrication and Application of Compression Packings,' was jointly presented by Mr. H. G. Koch, Section Chief in Charge of Packing Research, and Mr. A. J. Taylor, Section Chief in Charge of Packing Development, both of the Johns-Manville Research Center, Manville, N. J. The presentation was very effectively handled in two parts, both of which were replete with slide illustrations. Mr. Koch started with the research, development and production phase and Mr. Taylor followed by dealing with the design and application of packings to specific machinery.

"The talk was devoted in the main to the impregnated fabric types of compression packings, although considerable mention was made of the plastic types also. The highlights of this paper are adequately summed up in the following abstract:

"The functions of an impregnant or lubricant in a compression pack-

ing are (a) to fill the void spaces in the braided structure so as to block off leakage through the packing; (b) to permit the packing to flow readily under gland pressure so that it will seal with minimum pressure of contact against the shaft, and (c) to provide a low co-efficient of friction between the shaft and packing structure.

"Tests indicate that within substantial limits, the coefficient of friction of a lubricant is less important in its influence on the friction of a set of packing than the ability of the lubricant to provide easy conformance and efficient blocking.

"The packing designer must select from a wide variety of lubricants those which will afford satisfactory permanence in service. Properties which must be considered are resistance to bleeding under pressure or heat, and resistance to chemical attack or solution by the fluid to be sealed.

"To operate compression packing successfully, each individual ring must be forced into conformance to the shaft and box and the entire stack kept clean, cool, and lubricated. Cleanliness is the result of proper preparation of the equipment and care during installation. Cooling is attained by adequate leakage with particularly careful control of the leakage during the critical 'run-in' period. Adding a lubricant will increase the life of a packing but, of more importance, it will increase the life of the equipment. Various devices for the incorporation of lubricants have been tested. An external sealing medium can be used as an expendable fluid which serves to protect the packing from attack, minimize friction, and preserve the medium sealed, which may be too costly or dangerous to allow to escape.

"The correct selection of packing, common-sense techniques of operation, and properly lined up and supported machine elements with smooth surfaces in contact with the packing will result in the best possible service."

TWIN CITIES

Mr. H. R. Reynolds of the Fafnir Bearing Co. presented as his subject "Lubrication of Anti-Friction Bearings." Mr. Reynolds was formerly Chief Engineer of the above company and is now the Consulting Engineer in charge of lubrication problems. Not only was the subject of intense interest but the speaker, through his long experience, was able to answer many difficult questions.

CLEVELAND—1945-1950

The cover of the current issue carries a photograph of Cleveland. Mr. C. R. Schmitt, Program Chairman of the Cleveland Section, has submitted the following background story of the Cleveland-Youngstown Section:

"In March, 1945, the Cleveland-Youngstown Section of the American Society of Lubrication Engineers was organized. This organization took place two months following that of the first Section in Chicago. It is the third oldest A.S.L.E. Section in the country. The first Section Officers were:

Chairman: Mr. C. A. Bierlein, Cleveland Diesel Division, General Motors Corp., Cleveland, Ohio.
Vice-Chairman: Mr. R. J. Hagen, Republic Steel Corp., Youngstown, Ohio.
Secy.-Treas.: Mr. L. W. Fitch, Dingle-Clark Co., Cleveland, Ohio.

"An interesting sidelight of the first dinner meeting of the Cleveland-Youngstown group on March 25, 1945, was the fact that a considerable cash deficit, brought about by a disappointing turn-out, was paid out of the pockets of these Officers together with Mr. C. E. Pritchard, then President of the National Society. This may be of encouragement to a few of the recently organized Sections who may be struggling with such deficits. We hasten to add that this deficit was later made up by the National Society.

"Aggressiveness has characterized the functioning of the Cleveland-Youngstown Section since its inception. In addition to monthly technical meetings, the Section sponsors two outings yearly—one a golf party in the spring and the other a clam bake held in the fall.

"The average attendance at the monthly dinner meetings during the past year has been 60. Out of a total membership of 120, this attendance reflects favorably the efforts of the Officers and Committeemen in arranging and publicizing such meetings.

"Late in 1949, the Youngstown portion petitioned for a separate charter and is now functioning as a well-established Section.

"Located in the heart of a dense, widely diversified industrial area, there is no doubt that the second five-year period of the Cleveland Section will see a growth even greater than that experienced during the first."

MILWAUKEE

"Evaluating Lubricants by Test" was the subject of the March meeting. Mr. J. Krawetz, Phoenix Chemical Laboratories of Chicago, held the attention of his audience with a very carefully thought-out explanation of chemical testing of various lubricants and fuels. Mr. Krawetz has the rare ability to bring a complicated subject out in terms understandable to the average audience.

A forum discussion by the membership was held in April. Subject: "Cutting Oil vs. Soluble Oil in Machining Operations." Moderator: Mr. Richard Bussard, Chairman. This was a stimulating method of presenting a highly controversial subject.

CONNECTICUT

The Nominating Committee of this Section submitted new Officers for the 1950-51 season. A unanimous ballot for the entire slate was received. (See Section Officers' page.)

DAYTON

Secretary Sellers reports on the three recent meetings of his Section: "January—'Application of Polyether Type Lubricants in Industry' by Dr. J. M. Russ, Jr. of Union Carbide & Carbon Co. Dr. Russ opened his talk by explaining that synthetic lubricants are built up from smaller molecules and in so doing, it is possible to definitely control the finished product. He mentioned a few of the most common types of synthetic oils; i.e., Glycols, Esters, Silicones.

"In considering the Glycols, research and development indicates that there are four types that have the most desirable characteristics. The Polyglycol gives low wear rates, has good load carrying capacity and a natural low-pour point. While most of the development work has been with oils, Polyglycols have also been used in manufacturing of grease.

"The known uses for Polyglycols are: hydraulic fluid, rubber goods manufacturing, defoaming of boiler water, demulsifying agent, heat transfer oil, solvents and plasticizers, additive to fuels for model aircraft, metal forming, rust protection when inhibitors are added, compressor oils, packing impregnation — lubrication of fibre in textile industry.

"In closing, Dr. Russ pointed out that even though the cost is higher than that of conventional petroleum oils, tests and results indicate that the use of synthetic oil can be justified in special applications. How-

ever, due to the cost, petroleum oils will be used as a general lubricant for several years."

"February—'Practical Application of Cutting Oils' by Mr. Willam H. Oldacre, President and General Manager of D. A. Stuart Oil Co. Mr. Oldacre pointed out that much of their research and development work on cutting oils had been done with various types of E. P. testing machines. The use of E. P. tests indicates that there is a very close relation between cutting metal and lubrication of very heavily loaded bearings. With the use of slides, he discussed the film and chip formation, coolant vs. lubrication, and the advantages and disadvantages of water soluble cutting oils."

"March—'High Temperature Lubrication' by Mr. William M. Schuck of Armco Steel Corp. Mr. Schuck opened his talk by stating that, in his opinion, it was not altogether a matter of selecting a lubricant for high temperature application, but rather a need for a method to reduce the heat; thus making it possible to use petroleum products as lubricants. He used a graphic design of steel mill operation, showing the points where high heat conditions are encountered and the methods used to control the heat. The most important of these methods being design feature; second, application feature; third, method of lubrication. He further pointed out that the steel industry has not been able to take full advantage of the up-to-date petroleum products due to the wide range of equipment. While they have made use of some of these products, he feels that the solution to their major problem lies in the elimination of trouble through proper design features."

(This was the joint meeting with Cincinnati for the purpose of establishing a new section in the latter city).

YOUNGSTOWN

Secretary Jones reports on the two recent meetings of his Section:

"The subject discussed at the March meeting was 'Lubricants for Anti-Friction Bearing Application.' Mr. O. L. Maag, Chief Lubrication Engineer of The Timken Roller Bearing Company was the speaker. Mr. Maag's experience in this field enabled him to impart a wealth of information to those attending the meeting. A point of vital interest to all was mentioned in his opening remarks. 'Lubrication Engineering is one of the most important fields in the mechanical age. More and more, lubrication engineers are having their responsibilities increased. In many instances, the lubrication engineer saves his salary several times over in the larger industrial plants.'

"The principles of bearing lubrication and the wide field of their application was illustrated by film slides. Mr. Maag stated, 'Most passenger and pullman cars and thousands of freight cars are equipped with anti-friction bearings.' He predicted, in the not distant future all locomotives will have this type of bearing.

"Although the April meeting was not devoted to the subject of lubrication, we can say without any reservation that Mr. J. R. (Jack) McPhee, of the Ironsides Company, gave a very interesting talk on 'Greasing the Pigskin.' Jack is one of the Big Ten football officials and will be remembered as the first official to use the flag system instead of the whistle to call fouls.

"Among some of the anecdotes concerning outstanding players were included the seeming antipathy on the part of fans and players alike. Jack relates that after a particularly hectic afternoon at a major game, involving some 70,000 fans, he asked Mrs. McPhee, who happened to be at the game, just what her thoughts were or what emotional feelings took place as the fans booed and jeered a difficult decision that he was required to make. Jack no doubt was a little surprised when she calmly retorted, 'Why I just stand up and boo along with them.' After explaining the new rules and narrating other experiences, Jack was kept busy answering questions.

"We were glad to have members of the Cleveland Section with us and hope they will come back again."

PHILADELPHIA

Secretary Eismann reports:

"This section had Mr. Victor A. Ryan, Director, as a guest at their March 16th meeting. Mr. Ryan gave a brief talk on the status of the National organization. He urged each and every member to consider themselves to be the 'heart of the A.S.L.E.' and reminded them that the directors of the organization can do a better job for the organization if the individual members will do their part by sending in constructive suggestions and criticisms.

"After the business meeting Mr. T. G. Roehner, Technical Director, Socony-Vacuum Research Laboratories, presented a paper on 'Grease, An Industrial Lubricant.' The presentation began with a film and sound track which illustrated the processes used in the manufacture of calcium, soda, aluminum and lithium base greases. The film also showed the various laboratory equipment and methods used in testing grease both from the standpoint of manufacturing control and experimental evaluation.

"After the general picture of lubricating grease had been given, Mr. Roehner concentrated on the problems facing a lubrication engineer when he is asked to furnish a lubricant for a specific application or when a new lubricant must be constructed in order to 'lick a new application.' The following points must be considered:

1. Method of application — Individual greasing, central system lubrication, easily accessible, relatively inaccessible.
2. Operating temperature — Low, average, high, relatively constant, wide variation.
3. Frequency of lubrication — Irregular, regular, sealed 'for life.'
4. Possible contaminants — Water, dirt, solvents, chemicals.
5. Bearing design — Continuously fed, reservoir.
6. Operating conditions — Speed, load.
7. Cost.

Mr. Roehner emphasised that in lubricating bearings the requirements of the bearing should dictate the type of grease to be used, not the type of equipment available for application. Mention was also made of the cooperative work now being carried on by the grease industry and grease dispensing equipment manufacturers on the problems of grease pumpability and slumpability in dispensing equipment.

Mr. Robert Ulrich, Bethlehem Steel Company, led the discussion period in which questions pertaining to the status of 'multipurpose greases' and lithium base greases as industrial lubricants were given considerable attention."

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PERSONALS

W. B. Joachim: Tide Water Associated Oil Co., Inc., 1616 Walnut St., Philadelphia 3, Pa.—We regret to announce the death of William B. Joachim. Mr. Joachim was the Industrial products Sales Manager in the Middle Atlantic Dept. of the above company, with headquarters in Philadelphia.

A graduate of Cornell, he had been associated with the Philadelphia office for more than 27 years.

Mr. Joachim was an active member of A.S.L.E. and gave freely of his time and knowledge to the Philadelphia Section.

His loss will be felt by all who knew him.

Roeder — District Mgr.: Brooks Oil Co., 315 E. Carson St., Pittsburgh 19, Pa. — President Fred H. McCurdy announces the appointment of Mr. Carl O. Roeder as Southern District Manager for the above company, with headquarters in Birmingham, Ala. Mr. Roeder will direct Brooks sales and engineering activities in all Southern states east of the Mississippi. This company manufactures industrial lubricants and greases.

Barth at Gulf: Gulf Oil Corp., 3701 Gulf Bldg., Pittsburgh 19, Pa.—Mr. Edwin J. Barth, Petroleum Technologist, has joined the above company as a Technical Consultant in the General Sales Division.

Durso Advances: Fiske Bros. Refining Co., 129 Lockwood St., Newark 5, N. J.—Mr. L. A. Ryan, Vice President of the above company, advises that Mr. Anthony J. Durso has been placed in charge of the Eastern Domestic Sales Division, with the tile of Eastern Sales Manager.

Trabon Appoints: Trabon Engineering Corp., 1814 E. 40th St., Cleveland 3, Ohio.—Mr. L. W. Deutsch, sales manager for the company, announces that three new sales representatives have been named. The firms are: Kendall Engrg. Sales Co. of Milwaukee, for Wisconsin; Grant Watson Construction Co. of Denver, for Colorado and Wyoming; Engineering Associates of Omaha, for Nebraska and South Dakota. Mr. Deutsch states that their sales program is being stepped up to include more complete coverage of all industrial plants throughout the U. S. and abroad.

OUR COVER

Cleveland, located on the shores of Lake Erie, is Ohio's first city and the nation's sixth.

Largely industrial in character, with emphasis on steel and parts manufacturing, her central position offers numerous and widespread advantages.

Many of the largest meetings and expositions are housed annually in the well-known Public Auditorium. Cleveland is often designated the "Convention City."

Cultural and educational institutions have served an important role in the city's progress. Case Institute of Technology is among the country's top engineering schools.

The third oldest and one of the most active Sections of A.S.L.E. is well established in Cleveland. Please Note: The Board of Directors of A.S.L.E., at their recent meeting in Philadelphia, officially selected Cleveland as the 1952 Convention city for the Society.

"SLIPSHOD AMERICANS"

Mr. Walter W. Fuller of *The Detroit News,* well known commentator, columnist and author, was the luncheon speaker at our recent meeting in Detroit. Mr. Fuller, in the role of an evangelist, preaching the gospel of Americanism, sought to enlist every member of his audience as a missionary to go out on the highways and byways to resell America to the American people. He discussed the four lost arts in this country today; i.e., Conversation, Reading, Thinking and Prayer. Mr. Fuller bombarded his audience with facts demonstrating the lack of attendance at the polls and illustrating the general lethargy of the voting public.

To paraphrase a popular saying, "It is later than you think; enjoy yourself," Mr. Fuller states it this way, "It IS later than most of us think, BUT it is not a time to enjoy ourselves."

BOOK REVIEW

TECHNIQUES OF PLANT MAINTENANCE—1950

Published by

Clapp & Poliak, Inc., New York 17, N. Y.

Price—$2.00

This work, covering the complete proceedings at the Plant Maintenance Conference held concurrently with the show in Cleveland, Ohio, January 16-19, 1950, includes text of prepared papers and addresses on all phases of plant maintenance. The two volumes comprise 278 pages, and include 47 pages of tables, diagrams, illustrations, graphs and charts; 554 questions submitted by the audience are answered in the second volume.

To those connected with any phase of lubrication, the panel discussions on Lubrication Practice will be of particular interest. The questions and answers and prepared discussions relating to this subject are of vital import.

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CURRENT LITERATURE

***Oil and Gas Journal*, Vol. 47, No. 37**

FOUR OIL COMPANIES IN BASIC RESEARCH PROGRAM
Anon.—p. 115

The University of Chicago's basic research program has 16 industrial companies participating, among them four oil companies (Shell Oil Co., Sun Oil Co., Standard Oil Development Company of New Jersey and Standard Oil Company (Ind.)

Vol. 48, No. 6, June 16, 1949

TREND TOWARD LARGER LUBE-OIL PLANTS REVEALED IN RECENT N.P.A. SURVEY
Weber, G.—pp. 82

The National Petroleum Association, an organization of petroleum refining companies, with headquarters in Washington, D. C., recently completed a survey of domestic facilities for manufacture of lubricating oils. The resulting data, representing the most complete and detailed compilation of its kind currently available, is here published.

Vol. 48, No. 7, June 23, 1949

NEW PROCESS SUCCESSFULLY DEFOAMS LUBRICATING OIL
Anon.—p. 240

The experiments described in the report "Attempts to Defoam Existing Oils by Processing," prepared for the National Advisory Committee for Aeronautics, are described. They related only to aircraft lubricants, but the results may have broader application. It was found that lubricating oil can be satisfactorily defoamed by recycling it through a column of activated charcoal.

Vol. 48, No. 19, September 15, 1949

VISCOSITY-TEMPERATURE CHARTS . . . OF INCREASED USEFULNESS
Donovan, G. C.—pp. 98, 100-101, 130

Accompanying this article are a number of very useful charts and tables, and the entire presentation of the subject can easily be clipped and filed for future reference. For those readers who may find larger-sized charts necessary for daily or very frequent use, the Journal has reprinted them in larger size. Copies may be obtained without charge by addressing letter of request to Reader Service Department, The Oil and Gas Journal,. P. O Box 1260, Tulsa.

Vol. 48, No. 26, November 3, 1949

TEXACO ADAPTS OIL TECHNIQUE TO OIL
Anon.—p. 46

A new petroleum-research technique known as a molecular distillation has been put into operation in the Beacon Research Laboratories of The Texas Co. to further the study of lubricating-oil manufacture. The technique, according to Dr. W. E. Kuhn, manager of the technical and research division, provides hydrocarbons not previously available through ordinary distillation. It is hoped, he added, that the new application of this old technique "not only will make possible the design of more accurate and economical refinery equipment, but also will provide information leading to improved lubricants."

Vol. 48, No. 27, November 10, 1949, API Number

5-W LUBRICANT GETS QUALIFIED APPROVAL IN REFINING SESSION
Anon.—p. 190

The new 5-W classification of motor oil, first marketed in quantity last winter to improve low-temperature starting in cold climates, was given a qualified O.K. Discussion brought out additional points: 1) Starting at —20°F. poses problems other than oil viscosity, and oil is not alone responsible for starting difficulties under such conditions; and 2) 5-W is a classification of viscosity alone, and important quality requirements not specified are the responsibility of manufacturers. Reclaimed oil was discussed.

SPECIAL A.P.I. SECTION
Anon.—pp. 203-214, 218, 221, 223, 226, 229, 230, 233, 235, 236
Overall Appraisals, Specific Topics.

A.P.I. Committee Groups and Their Functions.

Highlights of A.P.I. Technical Papers (Summary of Paper of 39th Annual Meeting, Chicago, November 8-10, 1949).

Petroleum Outlook—1950, by Salmon, J. H.

RELATION OF KINEMATIC TO SAYBOLT VISCOSITY
Nelson, W. L.—p. 376

The following equation for relating kinematic viscosity with Saybolt Universal viscosity:

$$\frac{Z}{S} = 0.219t - \frac{180}{t}$$

Z=viscosity in centipoises
S = specific gravity at same temperature
t = Saybolt Universal time (sec.) at same temperature

was published in 1921 by W. K. Herschel, American Society of Civil Engineers, 84, 527 (1921). Later (about 1939) the U. S. Bureau of Standards made additional experiments and changed the 180 constant to 149.7, which is the value shown in the second and third additions of Petroleum Refinery Engineering.

$$\frac{Z}{S} = 0.219t - \frac{149.7}{t}$$

The Oil Marketer (Oildom Publishing Company), Vol. 16, No. 11, June 6, 1949

SEVERE CONTAMINATION, WEAR IS CAUSED BY PROLONGED OIL USE
Anon.—pp. 1, 4

The article refers to the lubricating oil tests reported to the May meeting of the Lubrication Committee of the API, at Colorado Springs. Two papers (one by Howe, W. A., Drake, J. F. Jr. and Donaldson, H. H., the other by Perriquey, W. G., Haworth, J. P. and Jenkins, G. N.) describing the tests and discussing the conclusions arrived at, are reviewed. The tests show that savings in long motor oil use are small and the engine damage is heavy. The vital importance of the 1,000-mile oil change interval in preserving the life of a car and in obtaining the most economical operation possible was stressed.

Oil, Paint and Drug Reporter. Vol. 156, No. 20, November 14, 1949

ATLAS OFFERS NEW FATTY ACIDS SERIES
Anon.—p. 4

A new series of fatty acids, said to have a true stearic acid content as high as 97 percent or more, has been made available to industry by the Atlas Powder Company, according to a joint statement by J. R. Frorer, general manager of the company's industrial chemicals department, and Henry Odeen, president of the Trandex Company, Memphis, Tenn. Three high purity hard acids, differing in uniform proportions of stearic and palmitic acids, are being offered. They include 70 percent, 80 percent and 97 percent stearic acids under the brand name of "Hystrene", a trademark of the Trendex Company.

Our Sun, Vol. 14, No. 2, Spring Issue, 1949 (Sun Oil Co.).

FACTS YOU SHOULD KNOW ABOUT INDUSTRIAL GREASES
Anon.—pp. 20-21

Many millions of pounds of lubricating greases were shipped each year from the Company's refinery at Marcus Hook. The shipments give evidence of the tremendous importance of grease in making the service of petroleum even wider and greater. Each grease is a combination of mineral oil with some other material, usually soap (fats), so a comparatively soft oily material can be obtained. The object is to provide lubricants for purposes where oil in liquid form is not applicable. It is possible to place greases into a number of broad classifications. One such division would refer to general purpose, that is, industrial greases as distinguished from automotive greases. The Company manufactures both kinds in a number of types, with railroad and marine greases, considered part of the industrial line. Another broad classification refers to the general type of grease resulting from the kind of soap base or thickener compounded with the lubricating oil in grease manufacture—sodium (soda) base greases from the use of sodium, and calcium (lime) base greases from the selection of calcium or lime soap in the product's make up. Still another division possible would be according to texture of finished greases. Sun's lime base greases are usually employed on industrial equipment where the operating temperatures are normal. The Sun line of sodium base greases finds industrial usage where higher temperatures are encountered. The right grease for the right place is a subject considered.

Petroleum, Vol. 11, No. 8, August, 1948

PARAMETERS FOR THE PUMPABILITY OF AERO-ENGINE OILS AT LOW TEMPERATURES
Peisakhodina, S. L. Shneerova, R. N. and Tarmanyan, G. S.—pp. 179-180, 194

It has usually been the practice to evaluate the behavior of aero-engine and automobile oils at low temperatures in terms of their pour points, of their viscosity indices and, more recently, by the measurement of their viscosities at low temperatures, determined under pressure. Each of these constants is considered in turn in this paper as an indication of the low-temperature behavior of an oil in an engine. This is a translation of a Russian article from Symposium on the Viscosity of Liquids and Colloidal Solutions, Academy of Sciences of the U.S.S.R.

SYNTHETIC MOTOR LUBRICANTS
Anon.—pp. 183-184

The article describes the tests of synthetic motor lubricants made on the equipment of the New York Power and Light Corporation. The two synthetic fluids tested were "Prestone" Nos. 200 and 300 motor oils, which are members of the "L.B." water-insoluble series of polyalkylene glycol derivatives. Their properties are discussed.

Vol. 12, No. 6, June, 1949

REFRIGERATION OIL
Anon.—p. 149

An all-purpose refrigeration oil, which has been developed to meet the demand of the refrigeration industry for high quality oil, has been introduced in the United States. It does not separate wax down to -70°F. in oil refrigerant mixtures. It is regularly tested for low moisture content, low wax content, and high stability. Tests show that the oil has a low pour point and will not decompose to form sludges or acids. It is said to be equally suitable for household refrigerators, deep freezers, meat counters, domestic and commercial cold storage lockers, and all other refrigeration and air-conditioning apparatus.

TESTING LUBRICATING OILS
Anon.—p. 138

It is reported that three new, laboratory methods have been developed to determine whether a specific lubricating oil sample is derived from a Pennsylvania or non-Pennsylvania crude source. These tests are based on the infra-red transmission characteristics, bromine number and refractivity intercepts of Pennsylvanian oils, which together provide sufficient data to differentiate them from other lubricating oils.

LUBRICATION AT EXTREME TEMPERATURES
Stuart, A. H.—pp. 139-141, 158

The running temperature of most bearing surfaces calling for lubrication lies within relatively narrow limits, but great advances made in engineering practice during the last few decades have, in some instances, called for lubrication at temperatures at both ends of the scale, which are far beyond the limits experienced only a few years ago. A whole new body of problems in lubrication has thus arisen, and the author considers their nature and the provisions which may be made for these new demands. Dry film lubrication, some properties of graphite and life of graphite film are covered.

Petroleum Engineer, Vol. 21, No. 5, May, 1949

DEVELOPMENT OF LUBRICATING GREASES
Matthews, R. R.—pp. C-41, C-43, C-44

The author reviews the development of sodium base, aluminum base, lithium base, barium base, zince base, and strontium base greases. A calcium base product using fatty acids in place of whole fat, pre-lubricated bearings, lithium-multi-purpose automobile lubricating grease and silicone lubricating greases are taken up.

LUBRICATION vs. BEARING LIFE
Mills, K. N.—pp. B-18, B-20

One of the controllable causes for excessive maintenance costs on modern oil field machinery is improper lubrication. Pointing out that anti-friction bearing failures are among the major causes of lost operating time on oil field machinery, the author outlines basic reasons why such bearings require lubrication.

Vol. 21, No. 6, June, 1949

VISCOSIMETER
Anon.—p. E-27

Developed for The Texas Company by Dr. Allan D. Garrison, the Texaco viscosimeter is described briefly. It was designed for the measurement of viscosity in plastic fluids and thixatropic suspensions, or any other non-Neutonian fluid, in which viscosity varies both with rate of shear and with time, as in drilling muds and cements.

RADIOACTIVE TRACERS USED IN RESEARCH ON ENGINE WEAR
Pinotti, P. L., Hull, D. E. and McLaughlin, E. J.—pp. C-5, C-8

The paper was presented before Society of Automotive Engineers, Detroit, Michigan, January 10-14, 1949. Radioactive tracers have been used successfully in developing an improved method for determining engine wear. The technique and results shown in this paper are an example of the application of radioactive materials in engine and petroleum product research.

FUELS AND LUBRICANTS FOR THE MODERN ENGINE
Pigott, R. J. S.—pp. C-47, C-50

The paper was presented before National Petroleum Association, Atlantic City, New Jersey, September 16, 1948. Having touched upon the petroleum reserves and the fallacy of the idea of obtaining our supply of petroleum by dividing proved reserves by annual consumption, the author discusses the possible engines of the future and the fuels which they will require. Fuels with increased octane value for higher compression ratio, the use of turbo-supercharger, the methods of raising compression ratio without raising octane value, the other sources of energy such as coal and electricity, hydro-electric plants and wind power, the fuels for heating purposes and the automotive fuels are discussed. Synthetics and shale-oil and coal as the source for same, the low conversion efficiency and the cost of synthetics, and the desirable lubricating oils are considered.

Vol. 21, No. 12, November, 1949

NEW LABORATORY WEAR TEST FOR AUTOMOTIVE GEAR LUBRICANTS
Anon.—p. C-47

Development of a new wear test procedure and apparatus for testing automotive gear lubricants under simulated service conditions is announced by the National Bureau of Standards. The unit is an adaptation of the SAE extreme-pressure lubricants testing machine. The unit and the procedure of testing are described.

OIL COMPANIES GRANT GRADUATE FELLOWSHIPS
Anon.—p. E-4

The Texas Company is establishing a graduate fellowship in chemical engineering at the University of Texas. The company has also established a graduate fellowship in the field of chemical engineering at New York University, and renewed a fellowship at the Georgia Institute of Technology. Magnolia Petroleum Company has established its fifth fellowship in the Southwest at Texas A. & M. Standard Oil Company of California has announced sponsorship of 36 new scholarships for the 1949-50 academic year in nine public universities.

NEW GREASE DEVELOPMENTS
Anon.—p. C-50

Advances made in grease making were discussed at the seventeenth annual meeting of the National Lubricating Grease Institute, at New Orleans, Louisiana, October 2-4, 1949. The newest developments in the experimental work on the manufacture of Bentone Greases were reported. Bentone products are formed by reaction between various organic cations and bentonite or montmorillonite, which forms a thixotropic gel in water used in drilling muds. The sodium ions in the material are replaced by ions such as ammonium alkyls, the choice of the cation controlling the product properties. Properties of Bentone greases are indicated. Important advances in aluminum stearate greases were reported also, traceable in great part to better, more purified fatty acids.

Petroleum Processing, Vol. 4, No. 1, January, 1949

MODERN SOLVENT REFINING OF LUBRICATING OILS
Kalichevsky, V. A.—pp. 32-36

In the general consideration of solvent processes in lube manufacture, the fact that the effect of solvents is often overlapping gives additional importance to setting up the proper sequence of refining steps. Advantages of solvent refining over sulfuric acid treating are discussed briefly. Fundamental principles of propane deasphalting are reviewed. The intricate structure of wax present in oil and the fact that structure may change under temperature and other conditions adds to the complexity of the dewaxing step.

Vol. 4, No. 8, August, 1949

LUBRICANT RECLAIMING WILL RECEIVE PANEL STUDY
Weil, B. H.—p. 853

The growing importance of the use of reclaimed lubricants is taken up. The increased use of rerefined oils by the air force is stressed. It was suggested that road tests of reclaimed and virgin oils be performed and results released to the public. The technical and economic aspects involved in the reprocessing of used lubricants and in the use of the reclaimed oils obtained, are touched upon.

CONVENTIONAL ENGINE TEST NOT REQUIRED IN PROCEDURE FOR ADDITIVE-TYPE LUBES
Anon.—pp. 911-912

A new evaluation test for additive-type lubricating oils, said to simulate the characteristic results of conventional engine tests, has been developed in the lubrication laboratory of the National Bureau of Standards by S. A. McKee and Ann Robinson Frits. The procedure and the apparatus are described.

Vol. 4, No. 9, September, 1949

LUBE OILS DEFOAMED BY ACTIVATED CHARCOAL
Weil, B. H.—p. 957

Referring to the paper "Attempts to Defoam Existing Oils by Processing" by J. W. McBain, the author discusses the tendency of oils to foam and methods of combating this tendency. He mentions the foam inhibitors (certain silicone compounds), recycling oils through a column of activated charcoal at 50°C. or lower, and other defoaming treating agents (activated magnesium oxide, silica gel and Porocel).

NEW TYPE HEAVY-DUTY MOTOR OILS CARRY UP TO 20% OF ADDITIVE
Guthrie, V. B.—pp. 981-984

The new high additive content motor oils, developed since the war for extreme heavy-duty service conditions, are now coming into commercial use, in Diesel engines particularly, and in gasoline engines in some instances. The new additives used are complex compounds of barium or other chemical substances, to give greater detergency than has previously been built into an oil. Included in them are oxidation inhibitors and specific compounds to neutralize the corrosion products of combustion which

(*Continued on page* 138)

OILS AND LUBRICANTS PATENT ABSTRACTS

Lubricants and Extreme Pressure Additives Therefor—Patent #2,498,628—Elmer B. Cyphers and Louis J. Osborne, Jr., assingors to Standard Oil Development Co.

An extreme pressure lubricant consisting essentially of about 80 to 99% of mineral base lubricating oil and 1 to 20% of an extreme pressure additive, said additive consisting of about 100 parts by weight of a sulfurized and phosphorized fatty material and about 4 parts of a composition selected from the group consisting of tricresyl phosphite and tricresyl phosphate, said sulphurized and phosphorized fatty material being prepared by first adding about 3 to 12% by weight of sulfur to said fatty material and heating the mixture to a temperature of about 330° to 400° F. for a sufficient time substantially to complete the reaction and thereafter reacting said sulfurized material with about 0.4 to 0.5% of P_4S_3 at a temperature of about 210° to 230° F. for about 5 to 8 hours.

Lubricating Oil Composition—Patent #2,498,863—Darwin E. Badertscher and Charles F. Feasley, and Henry G. Berger, assignors to Socony-Vacuum Oil Co., Inc.

A mineral oil composition comprising a viscous hydrocarbon fraction and a minor proportion, from about 0.05% to about 5.0%, of a compound represented by the general formula:

$$R'—A—R^2—B—R^3$$

where R′ and R^3 are tertiary lower alkyl groups; R^2 is a divelent lower alkyl group; A is a trithiocarbonate group; and B is a trithiocarbonate group.

Synthetic Process for Manufacturing Oily Products—Patent #2,499,488—Andre Gislon, assignor to Compagnie Francaise de Raffinage.

A process for continuously producing an oily product which comprises establishing and maintaining an elongated substantially vertical reaction-fractionation zone adapted for carrying out a Friedel-Crafts type reaction, said reaction-fractionation zone being of predetermined length, supplying to an upper portion of the zone a liquid phase aromatic hydrocarbon as well as a liquid phase complex reactant comprising the reaction product of an alkyl halide and an aluminum chloride catalyst, said complex reactant being diluted with a suitable solvent, supplying heat to the base of the zone to cause solvent vapors to flow upwardly in intimate contact with the liquid reactants and to cause a Friedel-Crafts reaction to proceed thereby yielding an oily condensation product, removing vaporized solvent as well as halogen acid from the top of the zone, condensing vaporized solvent, returning condensed solvent to the top of the zone as reflux, and removing an oily condensation product admixed with excess solvent and catalyst from a lower portion of the zone.

Anticorrosive Lubricating Oil and a Process of Fractionating Alkali and Alkaline Earth Metal Petroleum Sulfonates—Patent #2,499,710—Chester E. Wilson, assignor to Union Oil Co. of California.

An anticorrosive lubricating oil having high resistance to humidity consisting essentially of a lubricating oil and soaps selected from the class consisting of the alkali and alkaline earth metal soaps of petroleum sulfonic acids, which petroleum sulfonate soap is obtained as the raffinate from the treatment of a mineral oil solution of the corresponding untreated soap of a petroleum sulfonic acid at a temperature between about 100° F. and about 450° F. with a substantial amount of solid adsorbent so as to extract between about 5% and 30% of the soaps therein having a comparatively lower resistance to humidity.

Lubricants Containing Copolymers of Ethylene and Vinyl Acetate—Patent #2,499,723—Donald D. Coffman, and John F. Lontz, assignors to E. I. du Pont de Nemours & Co.

A composition of matter consisting essentially of an ethylene/vinyl acetate polymer and an ester which contains at least 10 carbon atoms and which is an ester of an aliphatic carboxylic acid and a primary aliphatic saturated monohydric alcohol, said polymer being completely soluble in said ester and having an ethylene:vinyl acetate mole ratio of from 1:1 to 6:1 and being contained in said composition in amount from 0.5% to 30% by weight of said ester, said polymer being that obtained by polymerizing a mixture of ethylene and vinyl acetate in excess of 50 atmospheres in contact with a polymerization catalyst.

Printed copies of patents are available from the Patent Office at twenty-five cents each. Address the Commissioner of Patents, Washington, D. C., for copies and for general information concerning patents.

From Official Gazette—Vol. 631, No. 4; Vol. 632, Nos. 1, 2, 3, 4; Vol. 633, Nos. 1, 2, 3.

Prepared by ANN BURCHICK

Polyester Lubricants—Patent #2,499,983—Ellington M. Beavers, assignor to Rohm & Haas Co.

A bland, oily product which is a condensate of (1) a saturated aliphatic, monocarboxylic acid of six to nine carbon atoms in branched-chain arrangement, R′COOH, (2) an acyclic, saturated, non-tertiary glycol of seven to ten carbon atoms in branched-chain arrangement, HOR″OH, and (3) an acyclic, saturated, aliphatic, dicarboxylic acid of six to ten carbon atoms, HOOCRCOOH, the molar ratio of the residue of said dicarboxylic acid to said monocarboxylic acid in said condensate being from 0.25 to 3.8:1 and the proportion of residue of said glycol being defined by the relationship

$$\frac{N_L + 2N_A}{2} = N_G$$

where N_L represents moles of monocarboxylic acid, N_A represents moles of dicarboxylic acid, and N_G represents moles of glycol, and where in the above formulae R represents an alkylene group of four to eight carbon atoms, R′ represents a branched-chain alkyl group of five to eight carbon atoms, and R″ represents a branched alkylene group of seven to ten carbon atoms.

Synthetic Lubricants—Patent #2,500,159—Harry G. Doherty and Alexander N. Sachanen and Francis M. Seger, assignors to Socony-Vacuum Oil Co., Inc.

A process for the preparation of synthetic lubricants having high viscosity indices, low pour points, and good stability, which comprises: thermally and non-catalytically heating a charge consisting essentially of a normal, alpha mono-olefin having between about six and about fourteen carbon atoms per molecule, at a temperature falling within the range varying from about 700° F. to about 900° F. for a period of time from about ten hours to about one hour, respectively, and in the presence of a gas selected from the the group consisting of hydrogen, carbon monoxide, and mixtures of hydrogen and carbon monoxide, the partial pressure of said gas falling within the range varying from about 50 pounds per square inch to about 5000 pounds per square inch.

Synthetic Lubricants—Patent #2,500,160—Francis M. Seger and Alexander N. Sachanen, assignors to Socony-Vacuum Oil Co., Inc.

The method for preparing an oil of lubricating viscosity characterized by a viscosity index of at least about 100 and low pour point, which comprises: thermally and non-catalytically heating a charge consisting essentially of a straight chain normal, alpha mono-olefin having between five and about twelve carbon atoms and styrene, at a temperature from about 500° F. to about 700° F. for a period of time from about 10 hours to about one hour, respectively, the molar proportion of said normal, alpha mono-olefin in said charge being substantially greater than the molar proportion of styrene therein.

Conversion of 1-Olefins in the Presence of Lead Tetra-acetate—Patent #2,500,161—Francis M. Seger and Alexander N. Sachanen, assignors to Socony-Vacuum Oil Co., Inc.

The process for converting a normal, alpha mono-olefin having from six to about twelve carbon atoms per molecule, to a viscous oil characterized by high viscosity index and low pour point, which comprises: heating said olefin with lead tetra-acetate at a temperature between about 400° F. and about 700° F. for a period of time from about ten hours to about one hour, respectively, and under a pressure sufficient to maintain the olefin in substantially the liquid phase.

Method of Preparing Viscous Oils by the Thermal Condensation of Short Chain Mono-Olefins with Long Chain Mono-Olefins—Patent #2,500,162—Francis M. Seger and Alexander N. Sachanen, assignors to Socony-Vacuum Oil Co., Inc.

The method for preparing a viscous oil, which comprises: thermally and non-catalytically condensing, at a temperature between about 500° F. and about 750° F. for a period of time from about twenty hours to about one hour, respectively, an olefin mixture consisting essentially of a short chain mono-olefin having from two to six carbon atoms per molecule and a long-chain normal, alpha mono-olefin having from ten to thirty carbon atoms per molecule; said short chain and long chain olefins being reacted in such molar proportions that the mean value of the olefin chain length in the olefin mixture is from about six to about twelve carbon atoms.

Synthetic Lubricants—Patent #2,500,163—William E. Garwood, assignor to Socony-Vacuum Oil Co., Inc.

The method of preparation of a viscous oil, which comprises: polymerizing, at a temperature above 600° F. and below 750° F., a normal, alpha mono-olefin having from 5 to 18 carbon atoms with a material selected from the group consisting of a phosphorous sulfide, elemental phosphorus with elemental sulfur, and mixtures thereof, the quantity of said material being less than one per cent by weight of the combined weight of said olefin and said material.

Synthetic Lubricant—Patent #2,500,164—William E. Garwood, Francis M. Seger, and Alexander N. Sachanen, assignors to Socony-Vacuum Oil Co., Inc.

The method of preparation of a viscous oil, which comprises: polymerizing, at a temperature between about 550° F. and about 750° F., for a period of time from about 20 hours to about one hour, respectively, a normal, alpha mono-olefin having from about 6 to about 14 carbon atoms, in the presence of an elemental substance selected from the group consisting of sulfur, selenium and tellurium, the molar ratio of said substance to said olefin being from about 0.01 to about 0.15.

Synthetic Lubricants—Patent #2,500,165—Harry G. Doherty and Alexander N. Sachanen and Francis M. Seger, assignors to Socony-Vacuum Oil Co., Inc.

The method for preparing a viscous oil from a normal, alpha mono-olefin having from about six to about fourteen carbon atoms per molecule, which comprises: thermally and non-catalytically heating a hydrocarbon charge consisting essentially of said olefin in the presence of a minor and effective amount of a paraffin, at a temperature greater than about 700° F. for a period of time from about three hours to about one hour, and less than about 900° F. for a period of time from about one-half to about one-quarter hour.

Synthetic Lubricants—Patent #2,500,166—Francis M. Seger and Alexander N. Sachanen, assignors to Socony-Vacuum Oil Co., Inc.

The method for preparing a viscous oil from a normal, alpha mono-olefin having between six and about twelve carbon atoms per molecule, which comprises: thermally and non-catalytically heating a hydrocarbon charge consisting essentially of said olefin at a temperature between about 600° F. and about 750° F. for a period of time from about twenty hours to about one hour, respectively.

Synthetic Lubricants—Patent #2,500,203—Orland M. Reiff, Harry J. Andress, Jr., and Alfred P. Kozacik, assignors to Socony-Vacuum Oil Co., Inc.

The method of preparation of a viscous oil having a low pour point and a low cloud point, which comprises: heating a charge consisting essentially of a mono-olefin having between about 8 and about 18 carbon atoms per molecule and a vinyl aromatic compound, in the presence of a catalyst comprising an association of silica and an amphoteric metal oxide, at a temperature between about 300° F. and about 600° F. for a period of time sufficient to effect condensation of said mono-olefin and said vinyl aromatic compound, the charge containing from about one to about two molar proportions of said mono-olefin per molar

proportion of said vinyl aromatic compound.

Lubricant—Patent #2,500,498—Orland M. Reiff and Harry J. Andress, Jr., assignors to Socony-Vacuum Oil Co., Inc.

A mineral oil composition comprising a major proportion of a viscous mineral oil fraction, a minor proportion, from about 0.4% to about 1%, of an alkyl phenyl phosphite and a minor proportion, from about 0.2% to about 1%, of a lower alkyl-substituted thiophene.

Synthetic Lubricants—Patent #2,500,672—William E. Garwood, John W. Brooks, and Alexander N. Sachanen, assignors to Socony-Vacuum Oil Co., Inc.

The method of preparation of a viscous oil, which comprises: condensing, at a temperature between about 500° F. and about 800° F. for a period of time sufficient to effect condensation, one molar proportion of a normal, alpha mono-olefin having from 5 to 18 carbon atoms per molecule, from about 0.01 to about one molar proportion of a conjugated olefinic hydrocarbon and from about 0.001 to about one molar proportion of a thiol.

Polymerization of Cycle Oil from High-Temperature Steam Cracking Process—Patent #2,500,755—Minor C. K. Jones, assignor to Standard Oil Development Co.

The method of obtaining more valuable products from a high-temperature steam cracked cycle oil boiling in the range of about 350° F. to 700° F., which comprises contacting said oil in liquid phase with an active polymerizing adsorbent at a space velocity between ½ to 2 volumes of the oil per volume of the adsorbent per hour while the adsorbent is at a temperature in the range 350° F. to 450° F.

Lubricant Composition—Patent #2,500,762—Eugene Lieber, assignor to Standard Oil Development Co.

Product consisting essentially of a high molecular weight polymeric condensation product of 0.5 to 10 mols of an alkylated aromatic compound with 1 mol of a phosphorus halide, said product being substantially non-volatile at all temperatures up to about 500° F. under reduced pressure wherein the condensation catalyst consists essentially of 0.2 to 2.0 mols of a Friedel-Crafts catalyst per mol of phosphorus halide.

Wire Drawing Lubricant—Patent #2,500,810—Frank A. Fink, assignor to The American Steel and Wire Co. of New Jersey.

A wire drawing lubricant comprising a dry mixture of from approximately 20 to 30% ferrous sulphate having water of crystallization and 70 to 80% of an anhydrous water soluble soap containing not more than 5% moisture, the percentages being by weight.

Screen Oil—Patent #2,501,646—William C. Morris, assignor to The Harshaw Chemical Co.

A screen oil composition essentially consisting of from 55 to 99 parts by weight of a terpene solvent and from 0.25 to 10 parts by weight of benzyl cellulose the same also containing from 0.5 to 15 parts by weight of a resin of consistency at room temperature from that of a soft solid to that of a viscous liquid and selected from the group consisting of the methyl, ethyl and glycerol esters of rosin acid and hydrogenated rosin acid, and copaiba balsam; and from 1 to 40 parts by weight of a resin of melting point from 70° C. to 185° C. selected from the group consisting of polymerized terpenes and glycol esters of terpene acids.

Modified Lubricating Oil—Patent #2,501,731—Richard W. Mertes, assignor to Union Oil Co. of California.

A mineral lubricating oil containing a minor but effective proportion of about 0.2% to 3.0% of a complex formed by heating an oil-soluble metal petroleum sulfonate with an amount of an inorganic base selected from the group consisting of metal oxides, hydroxides, carbonates and bicarbonates together with mineral oil to a temperature of about 350° F. to 450° F., sufficient to take up about 5% to 45% based on the sulfonate of the inorganic base in said complex, to solubilize said complex in the oil and dehydrate the product, said inorganic base having the function of enhancing the detergent capacity of the sulfonate.

Modified Lubricating Oil—Patent #2,501,732—Richard W. Mertes, assignor to Union Oil Co. of California.

A mineral lubricating oil containing a minor but effective proportion, in the order of about 0.5% to 10%, sufficient to impart detergency characteristics to said oil, of a complex formed by heating an oil-soluble lead petroleum sulfonate with an amount of an inorganic base selected from the group consisting of lead oxides, hydroxides, carbonates and bicarbonates in the presence of mineral oil to a temperature of about 150° F. to 500° F., sufficient to solubilize said complex in the oil, to take up about 5% to 45% based on the sulfonate of the inorganic base in said complex and dehydrate the mixture, said inorganic base having the function of enhancing the detergent capacity of the sulfonate.

Phenate Compounded Oils—Patent #2,501,991—James O. Clayton and William H. Alderson, assignors to California Research Corp.

A composition of matter comprising a major proportion of a hydrocarbon oil of lubricating viscosity and about 0.1 to 2.5% by weight based on finished oil, of an alkaline earth metal salt of a phenol containing attached to the aromatic nucleus the group O—R, wherein R is an aliphatic group attached to oxygen through carbon and contains 5 to 30 carbon atoms, and wherein the position of the O—R group in relation to the metaloxy group is selected from the class of meta and para positions.

Lubricating Oils—Patent #2,501,992—James O. Clayton and William H. Alderson, assignors to California Research Corp.

A composition of matter consisting essentially of a major proportion of a hydrocarbon oil of lubricating viscosity and about 0.1 to 2% by weight of each based on finished oil of a phenate having the structure R—O—A—O—M, in which A is an aromatic nucleus, M represents an alkaline earth metal, R is a hydrocarbon radical of 5-30 carbon atoms attached to the oxygen atom through a non-benzenoid carbon atom and the R—O group is in meta position in relation to the O—M group, and a selenium compound having the formula $R_1—(Se)_m—R_2$, wherein R_1 and R_2 are hydrocarbon radicals of at least $\frac{2}{7}$ carbon atoms and attached to selenium by a non-benzenoid carbon atom, and m is 1 or 2.

Lubricating Composition—Patent #2,502,408—David E. Adelson, assignor to Shell Development Co.

A composition comprising a major amount of an oleaginous lubricating material and between about 0.1% and 5% of a reaction product obtained by reacting at a temperature ranging from 170° F. to about 350° F., a sulfur-free phosphorizing agent with a high molecular weight unsaturated cyclic ketone fraction containing at least 12 carbon atoms in a ratio of from 1:2 to 1:8, and thereafter treating the resulting reaction product with a sulfurizing agent in a ratio of from 0.5:1 to 1:1, at a temperature ranging from 240° to 450° F.

Reacting Blown Nondehydrated Castor Oil with Maleic Anhydride, Products, and Compositions Thereof—Patent #2,502,606—Harry M. Ullmann.

A modified castor oil consisting of the reaction product of blown castor oil still retaining the hydroxyl groups characteristic of raw castor oil and from 2 to 20 percent maleic anhydride reacted together at from 70° to 140° C. for at least one hour, and esterified by an aliphatic alcohol of carbon chain length not over seven.

Lubricant Composition—Patent #2,503,290—Henry D. Norris and John H. McCracken, assignors to Socony-Vacuum Oil Co., Inc.

A lubricant comprising, in combination, a major proportion of an oil of lubricating viscosity and a minor proportion, sufficient to improve the extreme pressure characteristics of the oil, of 2,2,3,4,5,5-hexachlorothiolane.

Barium Soap Grease Compositions and Method of Preparation—Patent #2,503,749—Theodore W. Langer and Oney P. Puryear, assignors to The Texas Company.

The method of preparing an anhydrous normal barium soap grease having good water and heat resistant properties and stable against oleaginous liquid and soap separation, which comprises saponifying in the presence of oleaginous liquid of lubricating viscosity constituting a fractional part of the oleaginous liquid employed in the final grease, an acidic soap-forming material containing a predominant proportion of soap-forming hydroxy fatty acids with barium hydrate at temperatures within the range of 170-200° F. to produce a saponified product of normal barium soap, heating the saponified product to effect substantially complete dehydration at temperatures above 260° F. but below 300° F., adding additional oleaginous liquid of lubricating viscosity in substantial amount to obtain a stiff adhesive grease consistency while cooling the dehydrated product to a temperature below 200° F., all of said operations being conducted with continuous stirring, and finally drawing the resulting anhydrous grease composition at a temperature below 200° F.

High Temperature Lubricating Grease—Patent #2,503,969—Harry W. Rudel and Arnold J. Morway, assignors to Standard Oil Development Co.

A lubricating grease composition consisting essentially of mineral base lubricating oil containing 20 to 40% by weight of the sodium soap of rapeseed oil, said composition having a substantial glycerine content and a content of 0.25 to 2% excess alkali calculated as free sodium hydroxide, 0.1 to 2% phenyl alpha napthylamine, and 0.1 to 1% of dibenzoyl acetone alkylene diamine wherein the alkylene group is selected from the group consisting of ethylene and propylene.

Treatment of Oil-in-Water Emulsions—Patent #2,504,019—Ike D. Hall, assignor, by mesne assignments, to Standard Oil Development Company.

A method for breaking an emulsion of oil in water which comprises adjusting the pH of said emulsion to a pH no greater than 6.0, admixing said acidified emulsion in at least equal amounts with a hydrocarbon having from 3 to 7 carbon atoms in the molecule sufficient to cause phase separation, settling the admixture to form a hydrocarbon phase and a water phase, and recovering said phases.

Lithium Grease—Patent #2,504,672—Bruce B. Farrington and Frank A. Leyda, assignors to California Research Corp.

A lubricating grease comprising: a mineral lubricating oil, a lithium soap in quantity sufficient to substantially thicken said oil, and an amount of a zinc dialkyl dithiocarbamate between about 0.1% and about 1%.

Reversible Lubricating Grease Composition—Patent #2,504,717—Arnold J. Morway and John C. Zimmer, assignors to Standard Oil Development Co.

An anhydrous, reversible lubricating grease composition consisting essentially of 50 to 90% by weight, based on the total composition, of a low cold test mineral oil thickened to a smooth homogeneous solid grease structure with 10 to 50% of barium soap of fatty acid having 12 to 24 carbon atoms, said barium soap having a pH value at least as low as 7.0 and being prepared by dissolving said fatty acid in said mineral oil, adding an aqueous-oil slurry of carbonate-free barium hydroxide, in not more than stoichiometrical proportions, based on the fatty acid, and heating the ingredients to a temperature of about 200° F. to form barium soap in situ.

Anti-Oxidants for Mineral Oil Lubricants and Compositions Containing the Same—Patent #2,504,742—Herschel G. Smith, Troy L. Cantrell, and John G. Peters, assignors to Gulf Oil Corp.

The process of preparing an addition agent for mineral oil lubricants which comprises heating from 1 to 4 mols of a monohydric phenol having at least one unsubstituted nuclear position, 1 to 4 mols of N-dimethylaniline and 0.5 to 4 mols of formaldehyde per mol of the phenol in the presence of an activated clay catalyst at a temperature not in excess of 350° F. to condense together the three reactants, and recovering the condensation product.

Anti-Oxidants for Mineral Oil Lubricants and Compositions Containing the Same—Patent #2,504,743—Herschel G. Smith, Troy L. Cantrell, and John G. Peters, assignors to Gulf Oil Corp.

The process of preparing an addition agent for mineral oil lubricants which comprises heating p-hydroxydiphenyl with from 4 to 9 mols of N-dimethylaniline and 4 to 9 mols of formaldehyde per mol of p-hydroxydiphenyl in the presence of an activated clay catalyst at a temperature not in excess of 350° F. to condense together the three reactants, and recovering the condensation product.

Lubricating Grease—Patent #2,504,779—David W. Young and William H. Smyers, assignors to Standard Oil Development Co.

A lubricating grease composition consisting essentially of 67 to 94% by weight of lubricating oil, 5 to 30% of a thickener to impart a colloidal grease structure to said oil, and 1 to 3% of a "cycalkene" copolymer containing between 40 and 65% by weight of a cyclic constituent.

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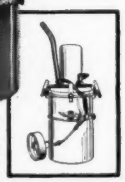

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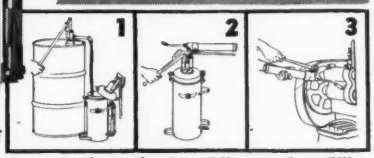

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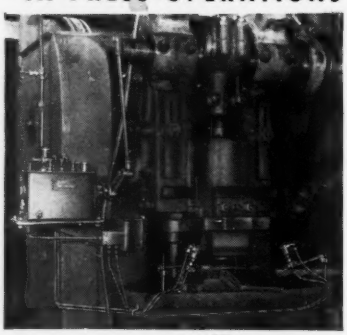

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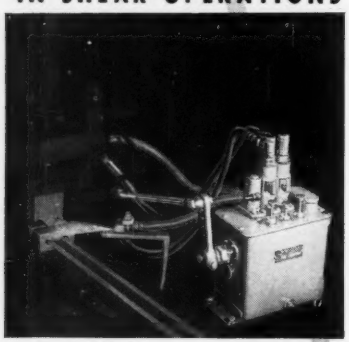

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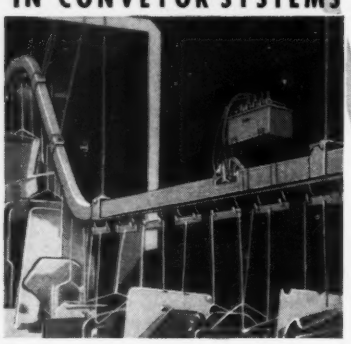

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CURRENT LITERATURE

(*Continued from page* 134)

are a principal cause of engine wear. The new oils, now made in the SAE 10 and SAE 30 grades, are recommended for severe engine operating conditions only. The new oils will make practicable the use of the higher-sulfur fuels coming into increasing use in present type Diesel engines without causing undue damage. The present commercial status of the new high-additive content oils, experimental work and extensive tests carried out by Shell Oil Co. and The Texas Co. are taken up.

SULFURIZED EXTREME-PRESSURE LUBRICANTS AND CUTTING OILS. PART I. LITERATURE SURVEY
Sellei, H.—pp. 1003-1008

This paper is a survey on the general subject of sulfurized oils and sulfur compounds, with particular reference to the use of such materials in extreme-pressure lubricants and cutting oils. The present survey covers the important contributions published in the English language up to 1948, with a few pertinent references from the foreign literature. Since the functioning of these lubricants is largely dependent upon their behavior under "boundary lubrication" conditions, the theoretical background of boundary lubrication, as known today, is presented along with the theories on the mechanism of the lubrication process using sulfurized lubricants. Ninety-eight references are given.

Petroleum Refiner, Vol. 28, No. 6, June, 1949

VISCOSITY ABACUS
Anon.—pp. 222-223

Belgian oil technologist, Michel Roegiers offers an abacus for determining the viscosities of mixtures of petroleum oils. According to Roegiers, "within the limits of ideal mixtures, the logarithms of viscosity are additive when the blending proportions of the component liquids are expressed in unit-fractions of inter-molecular attraction energy." (For further information apply to Michel Roegiers, Elektron Oil Laboratories, Coupure 221, Ghent, Belgium, referring to Petroleum Refiner item 280)

THE MANUFACTURE OF LUBRICATING GREASES. PART IV. ALUMINUM AND BARIUM-BASE GREASES
Boner, C. J.—pp. 127-130

The author describes procedures for making aluminum and barium base grease and describes the machinery requirements in this part (Part IV). The next part (Part V) will discuss lithium greases.

LUBRICATING OIL ADDITIVES. PART I
Kalichevsky, V. A.—pp. 97-102

Additives have been used extensively since the late 30's. The author discusses pour point depressants in this part and will later discuss, in future parts, additives for improvements of viscosity index, oiliness agents, oxidation inhibitors and detergents, dyes, anti-foam agents and rust preventatives. Some very interesting tables are included in Part 1 on pour point depressants as follows: — metallic compounds, metallic organic compounds, polymers and auto-condensation products, substances of indefinite composition (misc.). Table 2 shows physical properties of commercial pour point depressants. Table 3 shows agents recommended

(*Continued on page* 144)

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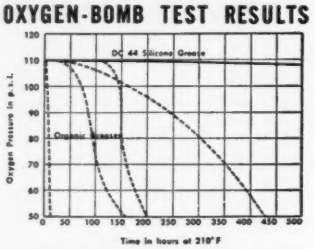

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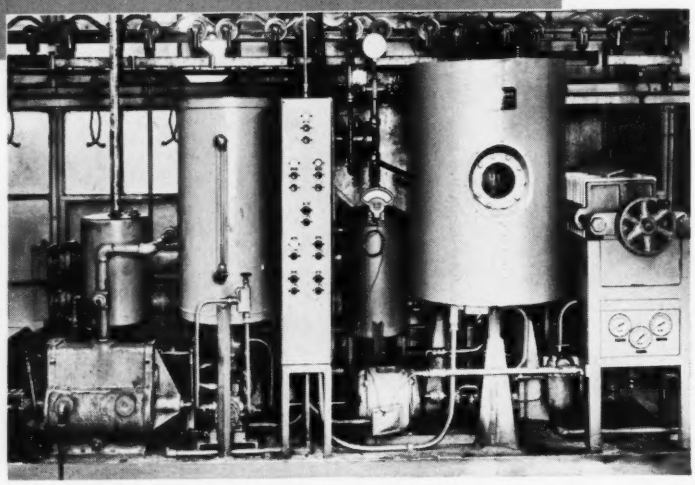

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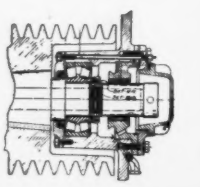

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(*Continued from page* 138)

for treating oils to depress pour points. Table 4 lists wax modifiers specifically recommended for use in the dewaxing processes. In all of the tables mentioned above the corresponding patents are listed so that the tables constitute a very fine bibliography on the subjects mentioned.

Vol. 28, No. 7, July, 1949

LUBRICATING OIL ADDITIVES. PART II. VISCOSITY INDEX IMPROVERS
Kalichevsky, V. A.—pp. 125-128

Viscosity index improvers form an important class of additives which made possible the development of a number of outstanding lubricants. The available information regarding their behavior indicates that their performance depends to a very considerable extent on the nature of the oil employed in blending and that further radical progress in the preparation of high viscosity index products will come in all probability from this direction. A comprehensive list of patents prepared for this article shows the types of compounds which might be employed to achieve the desired purpose. However, not all of them are in commercial use because of unfavorable effects on some other oil properties or similar considerations. Nevertheless it may be expected that new materials will appear on the market in the future in direct competition with those already available.

THE MANUFACTURE OF LUBRICATING GREASE. PART V. LITHIUM BASE AND MISCELLANEOUS LUBRICATING GREASES
Boner, C. J.—pp. 129-133

A series of patents issued to Earle on March 3, 1942 covered the use of lithium soaps in the manufacture of lubricating greases. At about the same time it was found that such lubricants could be made from low cold test oils so that they were especially adaptable for use as low-temperature aircraft lubricants. Strontium-base greases are also considered, as well as those containing calcium and barium, zinc and magnesium greases are also employed.

Vol. 28, No. 8, August, 1949

LUBRICATING OIL ADDITIVES. PART III. OILINESS CARRIERS
Kalichevsky, V. A.—pp. 121-126

Oiliness agents were the first additives developed for use in lubricating oils. For more severe service extreme pressure lubricants and anti-welding agents are employed. Although the oiliness agents are helpful when conditions of boundary lubrication are encountered, their indiscriminate use is not always warranted or desirable. Notwithstanding a considerable amount of experimental work done on this subject, many of the problems connected with the use of oiliness agents remain unanswered and conflicting results are often obtained with different testing equipment. The number of patents pertaining to oiliness agents is very great. For easy reference they are tabulated under various headings and alphabetically (pp. 123-125). Most of the recommended substances are of polar or slightly acidic and corrosive type requiring adjustments in quantities added to the oil for protecting the engine from excessive corrosion and wear. Because of the multi-functional nature of many additives their exact classification is often difficult, if not impossible. Part IV will appear in an early issue.

The Petroleum Times, Vol. 53, No. 1357, August 12, 1949

THE EVALUATION OF LUBRICATING OILS AT ANGLAMOL LABORATORIES
Anon.—pp. 703-704

The organization and activities of the research laboratory of Anglamol Ltd. at Hazelwood, near Derby, where the research covering lubricating oils and the lubricating oil additives is being carried on, is described. Eight photographs illustrate the equipment of the laboratory.

Vol. 53, No. 1359, September 9, 1949

PROGRESS IN THE SCIENCE AND ART OF LUBRICATION
Paterson, E. V.—pp. 783-784, 789

NEW BRITISH TEST ENGINE IN USE AT OLYMPIA
Anon.—pp. 793-795

First article. The author discusses the significance of physical and chemical tests of lubricating oils, and the modern internal combustion engine. The Sunbury Lubricating Oil Test Engine, New Ricardo Test Engine (Thornton Research Laboratories) and engine deposits are discussed: Ring sticking of aviation oils, screening and functional tests, dialkyl selenides as oxidation inhibitors, synthetic motor oil, extreme pressure lubricants, thread lubricants, and change of viscosity under high pressure are touched upon. Second article. The new British Ricardo test engine for testing fuels and lubricants is described. Adaptability of engine, the control panel and the four-channel oscilloscope are the features stressed.

Revue De L'Institut Francais Du Petrole Et Annales Des Combustibles Liquides, Vol. 4, No. 6, June, 1949

INFLUENCE OF THE PRESSURE OF EXTERIOR GAS ON THE OILINESS OF LUBRICANTS
Volovick, G.—p. D-79
(C. R. Acad. Sci., Vol. 227, No. 25, December 20, 1948—pp. 1354-6)

A series of curves giving the coefficient of friction as a function of time and corresponding to the pressure of gaseous atmospheres (air, carbon dioxide, ammonia and sulfur dioxide) was studied.

LUBRICATION OF HIGH-ALTITUDE AIRPLANES
Soderquist, A. A.—p. D-77
(Shell Aviation News, Vol. 115, Jan., 1949—pp. 14-18)

Special studies of lubrication of airplanes with oil and greases at low temperature prevailing at high altitudes are described.

THE USE OF COLLOIDAL GRAPHITE IN ASSEMBLY LUBRICATION
Smith, E. A.—p. D-78
(Engineering, Vol. 165, May 28, 1948—pp. 505-7)

Influence of the state of the surface upon friction, use of polarized lubricants with long chain and the speed of expansion of oils upon the friction surfaces are taken up. Behavior of the colloidal graphite and the resistance of surfaces lubricated with colloidal graphite to seizing are discussed.

SAE Journal, Vol. 56, No. 8, August, 1948

OIL TESTS WARN OF ENGINE WOES
Faber, R. L.—p. 68-69

This article is based on the paper, by the author: "Faber Engine Analysis for Internal Combustion Engines," presented at the SAE Metropolitan Section, New York, Oct. 21, 1948. Crankcase oil analysis forecasts vehicle engine troubles and points to economies such as maximum mileage before oil change. The complete analysis consists of six tests which are indicated.

FRICTION OXIDATION PLAGUES OSCILLATING BALL BEARINGS
Hilles, L. A.—pp. 69-70

The article is based on the paper, by the author: "Bearings in Action—Plague of Friction Oxidation," presented at SAE Philadelphia Helicopter Symposium, Dec. 10, 1947, and deals with the oscillating action which can accelerate ball bearing failure through friction oxidation, unless a bearing of suitable size is chosen. Extensive research with different kinds of bearing designs and greases gave rise to a theory explaining this action, by the "totalization of pressure per lubrication cycle."

Vol. 57, No. 5, May, 1949

NEW HEAVY-DUTY LUBE EXTENDS DIESEL LIFE
Edgar, J. A., Plantfeber, J. M. and Bergstrom, R. F.—pp. 68-69

The advantages of a new special heavy-duty lubricant for Diesels are indicated. It has several times the detergency, oxidation stability, additive stability to high piston temperature, and antiwear property of conventional oils of this type. The new oil combats effects of sulfur in fuel and improves cleanliness and wear of Diesels.

Vol. 57, No. 9, September, 1949

HOW OIL VISCOSITY AFFECTS ENGINE PERFORMANCE
Lane, J. W. and Chatfield, D. S.—pp. 66-69

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for 15 years!
The TAYLOR-WINFIELD Corporation, Warren, Ohio, insist upon components that meet highest performance standards of their famed T-W Resistance Welders. Norgren Lubricators and Regulators (circled) are used with a new type manifold that is a feature of T-W Welders. They write:
"After exhaustive tests in the laboratory and under actual production conditions, our engineers have come to the conclusion that Norgren Regulators and Norgren Lubricators are their choice because of their economy and performance. Taylor-Winfield has used Norgren equipment for approximately 15 years"!
NORGREN REGULATORS
...feature Baffle Plate and Siphon Tube action, permitting greater air flow with less pressure drop... respond faster... protect against shocks and chatter.
NORGREN LUBRICATORS
...develop air-oil fog that coats all internal parts of equipment reached by air... have visible oil feed... are refilled without shutting off the air... are compact, simple to install and maintain.
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Norgren
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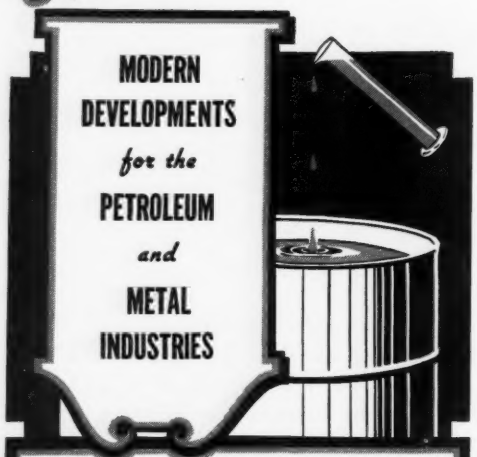

BURNS LABORATORIES INC.
INDIANAPOLIS, INDIANA

Copy of this booklet available upon request.

Excerpts from paper "Effect of Lubricating Oil Viscosity on Engine Performance," read at SAE Summer Meeting, French Lick, June 6, 1949, are presented. Preliminary results from tests evaluating effects of viscosity of engine oil on engine performance (including 2-104 B heavy-duty oils ranging from SAE 10 to SAE 50 and a 5W grade) showed that: 1. oil consumption increases as oil viscosity decreases, differences becoming more pronounced as engine mechanical conditions become poorer, 2. engine sump and main bearing temperatures increase with oil viscosity, becoming excessively high with SAE 50 grade, 3. friction horsepower increases slightly as oil viscosity increases, but to such slight degree that it is unnoticed in actual car operation, 4. engine wear from mechanical causes is little affected by oil viscosity. But improper use of a very light oil, such as 5W, may cause increased piston ring wear when ambient temperatures are high, and 5. oil deterioration increases as viscosity decreases, but petroleum ether insolubles—a measure of contamination—appears independent of viscosity. Length of service directly affects petroleum ether insolubles.

SAE Quarterly Transactions, Vol 3, No. 3, July, 1949

SPECIAL HEAVY-DUTY TYPE ENGINE OILS
Edgar, J. A., Plantfeber, J. M. and Bergstrom, R. F.—pp. 381-390

This paper was presented at the SAE National Fuels and Lubricants Meeting, Tulsa, Oklahoma, Nov. 4, 1948. Described here is a change in oil compounding practice that appears to compare in potential performance improvement with the revolution of the 1930's, when lubricating oils containing metallic soaps were introduced. An extremely high degree of detergency is balanced with a new level of additive stability at high piston temperature. In addition, the ability of the new oil to retain anticorrosion properties when used with high sulfur fuel has almost completely eliminated the wear of cylinder bores from this source. In addition to evidence of improved cleanliness, the horizon of tolerable sulfur content has been extended by at least a factor of 3, and there is sound reason to believe that the stability at high piston temperatures is sufficient to cope with engines of greatly increased specific output. A discussion follows.

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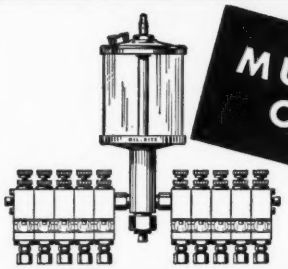

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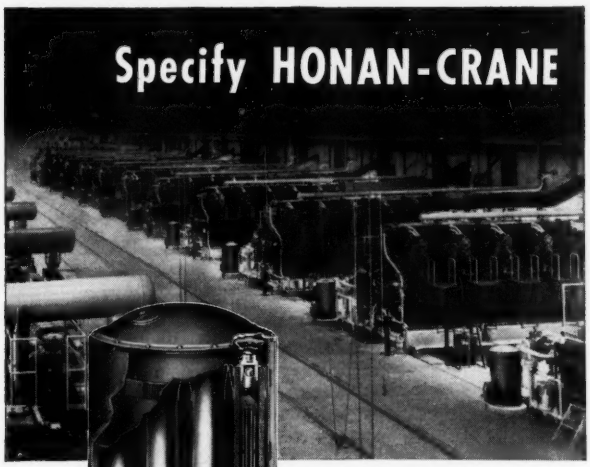

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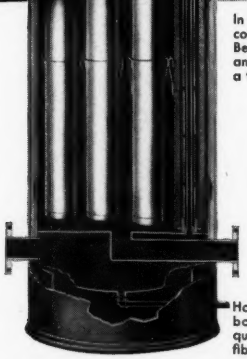

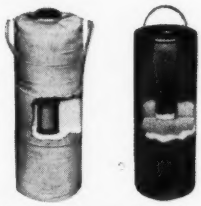

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Advertisers IN THIS ISSUE

Acheson Colloids Corp. 107
Alemite 105
Aro Equipment Corp., The 137
Bowser, Inc. 142
Brooks Oil Co., The 148
Burns Laboratories, Inc. 146
Cincinnati Milling Machine Co. 104
Classified Ad 121
Dow Corning Corp. 142
Farval Corporation, The . . . . . Inside Back Cover
Fiske Bros. Ref. Co. (Lubriplate Div.) 144
Grafo Colloids Corporation 146
Hodson Corporation, The . . . . . Back Cover
Honan-Crane Corp. 147
Houghton, E. F. & Co. 103
Lincoln Engineering Co. 109
McGraw-Hill Book Co., Inc. 141
Madison-Kipp Corporation 102
Manzel, Inc. 138
Morgan Construction Co. 108
Norgen, C. A., Co. 145
Oil-Rite Corp. 147
Shell Oil Company, Inc. 143
Sinclair Refining Co. 147
Stuart, D. A., Oil Co., Ltd. 101
Sun Oil Company 106
Tide Water Associated Oil Co. 139
Trabon Engineering Corporation . . . . . Inside Front Cover
Warren Refining & Chemical Co., The 137

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Good lubrication—vital to trouble-free operation—is provided by Farval Centralized Lubrication, which is offered as optional equipment on every machine.

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"Centralized lubrication with Farval is a distinct aid to positive lubrication of hard-to-get-at places which previously required the machine to be shut down to reach the hidden bearings that were frequently missed entirely, either intentionally or due to an oversight.

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Write for Bulletin 25 for full details. The Farval Corporation, 3267 East 80th St., Cleveland 4, Ohio.

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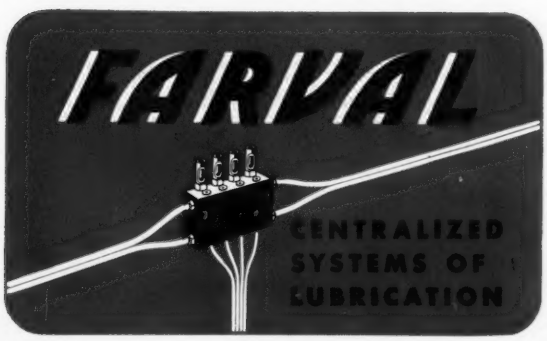

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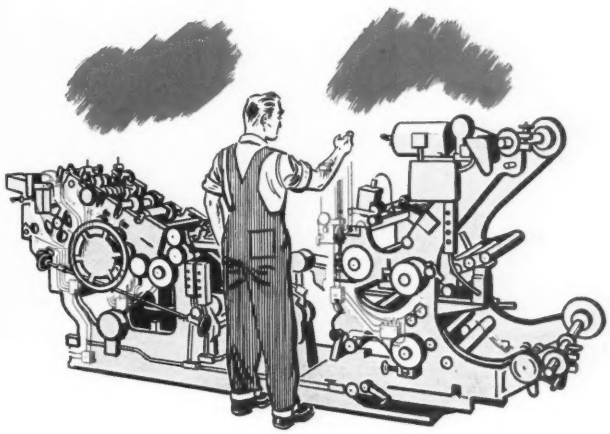

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